WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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LOCK REPAIRING AND KEY FITTING.

BY THOS. WILSON.

BACK-SPRING AND TUMBLER LOCKS.

No doubt most if not all the readers of WORK have at some time or other had occasion to employ a locksmith. Now, I do not say that after reading the following article they will be able to entirely dispense with his services, but I purpose showing how any workman, professional or amateur, can keep his own locks in repair. There are several reasons why they should do so, and before commencing this article I will mention one or two.

In the first place, there is the saving of money. Workmen's time in London and most of the large towns is charged for at the rate of a shilling per hour, and although the number of hours are not generally specified in the bill, that is the price the customer has to pay. I have frequently seen bills made out as follows: Man's time, taking off, cleaning, repairing, and fitting new key to lock—two shillings and sixpence. This represents two hours' time, and sixpence for the key. In the country the customer would probably be charged three hours' time at ninepence. If the reader follows the directions I am going to give him, I think he will be able to save two shillings out of the half-crown.

Besides the question of cost, there is a graver reason why householders should do their own locks as far as possible.

"It is an ill bird that fouls its own nest," and I have not a word to say against workmen in general, but there are black sheep in every fold. What is to prevent a man when fitting a key for a front door or safe lock from fitting an extra one for his own use? Of course, he would not use it at once; it would be laid by for a year, perhaps two, but he would be sure to use it at some time or other. For my part, I am convinced that many burglaries take place in this way.

One more reason, and I have done. When a workman takes a lock into the shop that requires a key, he has a key or blank served out to him, and it is charged to the job. If, through carelessness or ignorance he cuts the key wrong, he will have to apply for another, and will come in for a "wigging" from the shop foreman. Sooner than do this, he will take out the wards or alter the levers of a lock, and so fit the lock to the key, instead of the key to the lock, thereby reducing a good lock to the level of a bad one. Having, I hope, shown why locks should be repaired at home, I will now proceed to show how. First as to tools. Well, the only tools absolutely necessary are a vice, hammer,

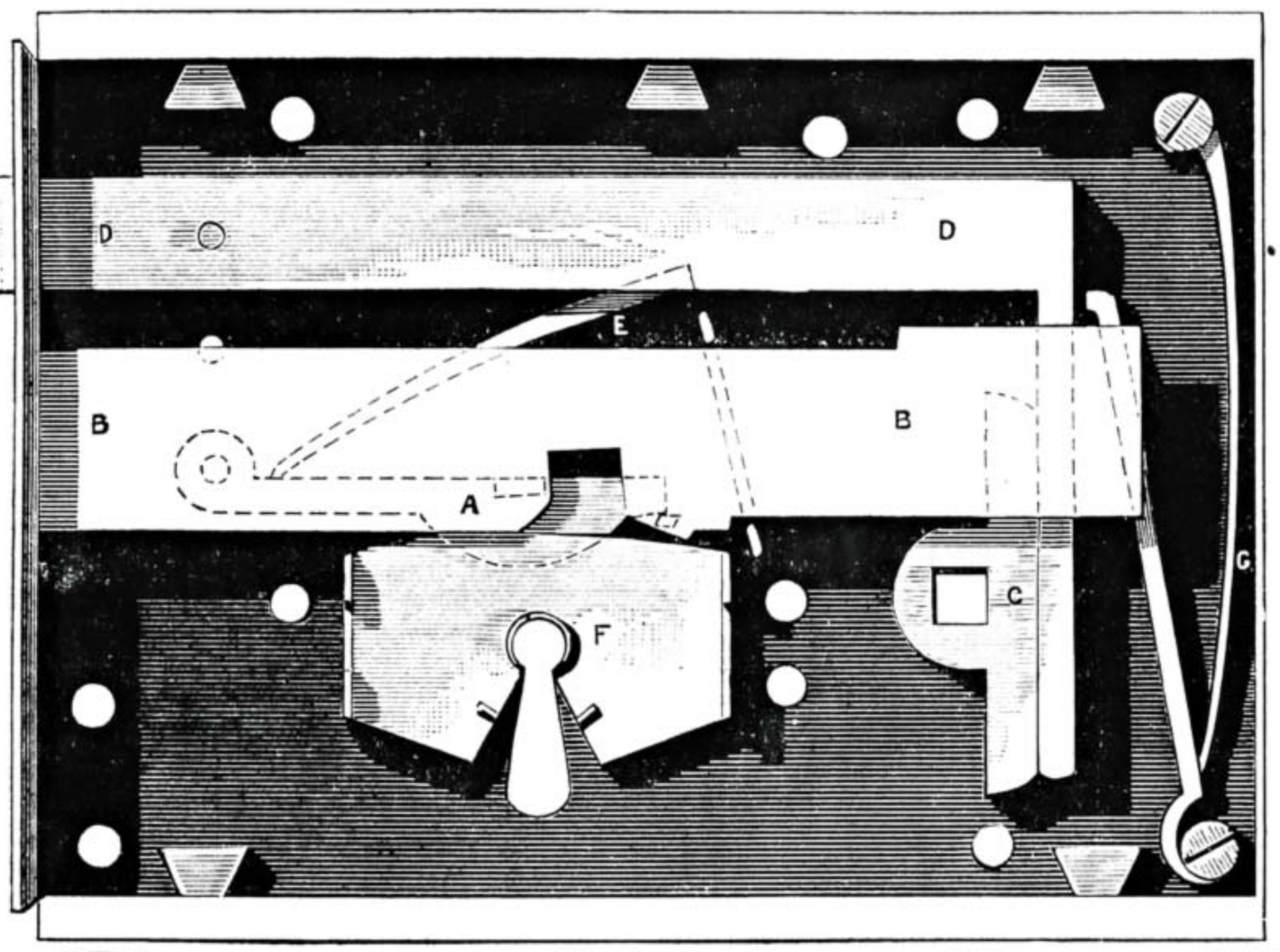


Fig. 1.

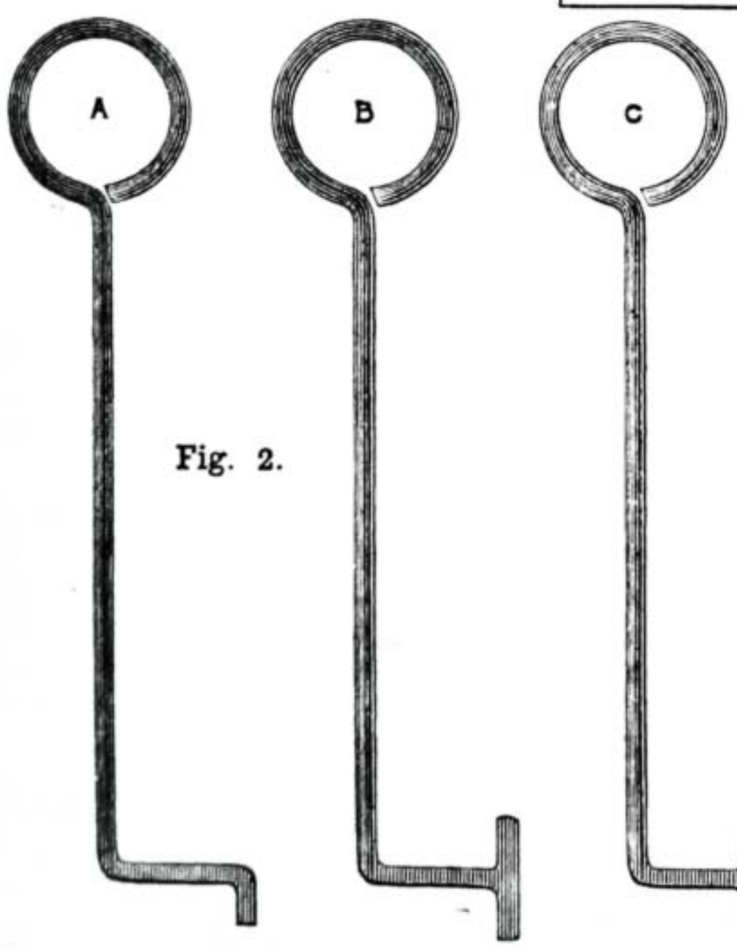


Fig. 2.

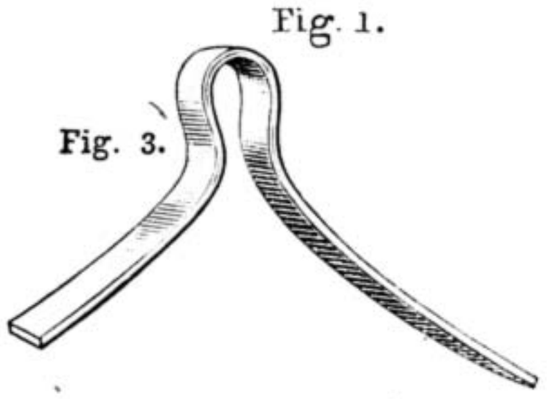


Fig. 3.

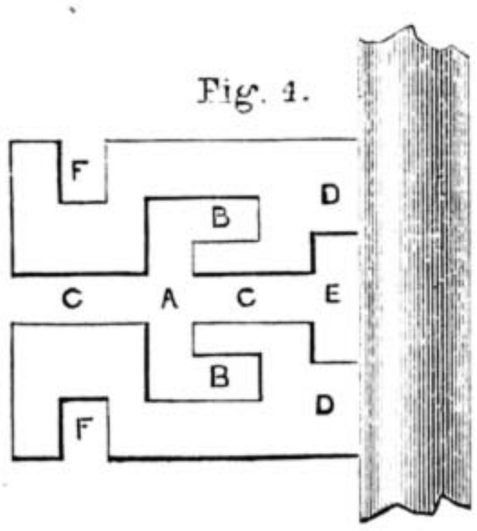


Fig. 4.

Fig. 5.

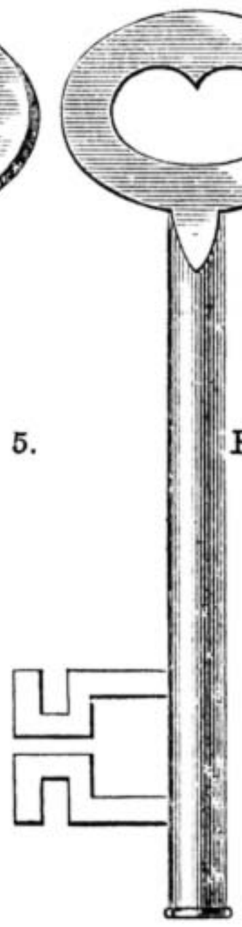


Fig. 6.

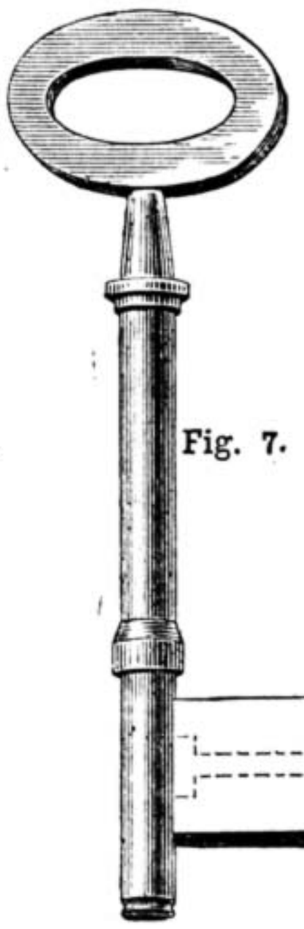
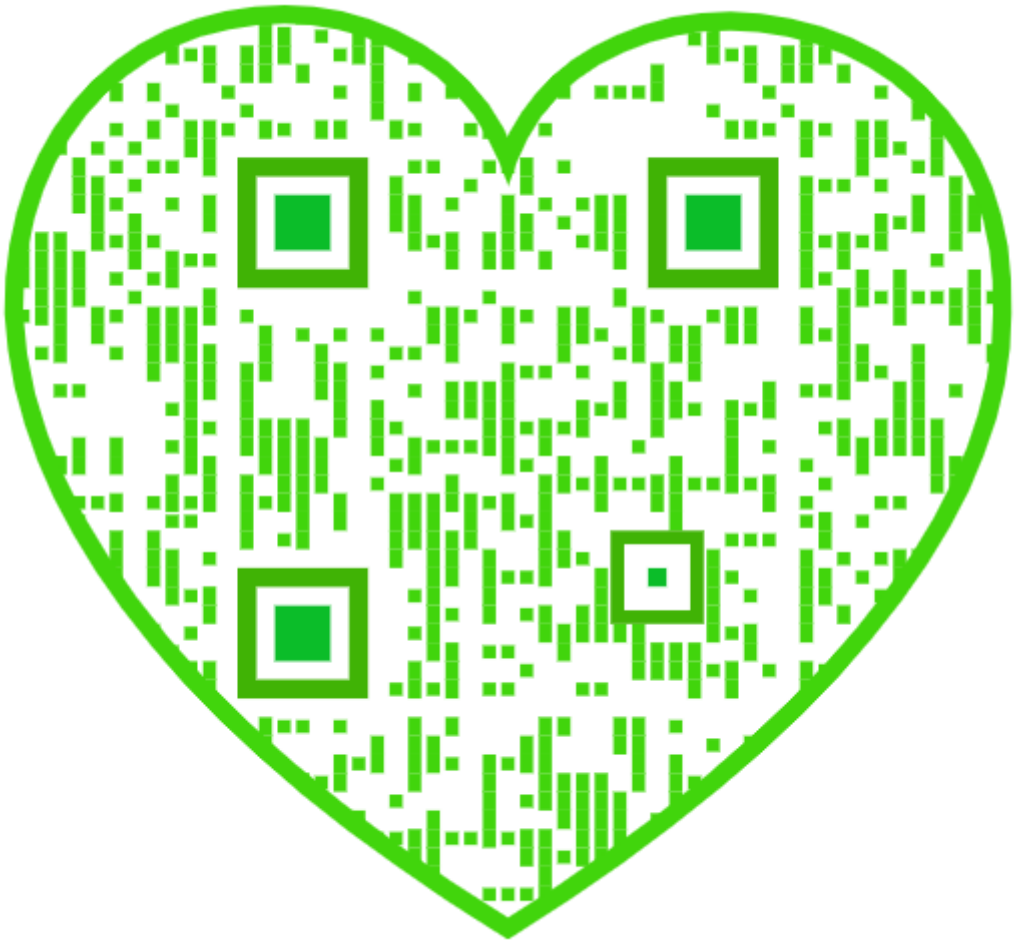


Fig. 7.

Fig. 1.—Interior of Ordinary Back-spring and Tumbler Lock—A, Tumbler; B, Bolt; C, Follower; D, Catch; F, Keyhole Plate; G, Feather Spring. Fig. 2.—Different Forms of Picks. Fig. 3.—Scotch Spring. Fig. 4.—Enlarged Diagram of Key in Fig. 5—A, Spot at which to Drill Hole in Blank; B, B, the L Wards; C, C, Bridge Wards; D, D, Parts at which Key is liable to break when cutting L Wards; E, Collar Ward; F, F, External Wards. Fig. 5.—Key belonging to Lock. Fig. 6.—Skeleton Key capable of Opening Lock. Fig. 7.—Blank with Bridge and Collar Wards Cut.



screwdriver, and a few warding files and chisels. Other tools will be described for the benefit of those who may care to purchase them, but, although, of course, it is better to have them, they can be dispensed with. Every house possesses a hammer and screwdriver of some description, so that brings us down to the vice, warding files, and chisels. Most amateurs possess a vice, but those who do not can get one for about half a crown that will answer the purpose; though it will be better to give a little more if it is intended for any other use. Some vices have small square anvils, or heads, attached to them, and these will be found of great service in key fitting. Warding files can be purchased for threepence or fourpence each, and chisels for about sixpence.

Having got our tools together, and the vice fixed, we will now commence work. We will commence with the ordinary backspring and tumbler locks, as they are more frequently used than any other, and will afterwards take the Bramah and the various kinds of lever locks.

The one shown in Fig. 1 is a fairly good one of its class, but it will be seen that a skeleton key of the description shown in Fig. 6 will open it as easily as the original. The keys of a tumbler lock rarely, if ever, have corresponding wards in the lock to more than one or two cuts in the key, as will be seen on looking at the illustration. Skeleton keys are made in a variety of patterns, and will pass almost any warded lock; in fact, warded locks, although still made by thousands, are gradually being superseded by lever locks. If a skeleton key will not pass the wards, they can easily be found by first holding the key in the flame of a candle, lamp, or gas, until it is blackened, or covering it with a film of wax, then inserting it in the lock, and pressing it against the wards. On removing the key the impression of the wards will be found on it, and when these are cut away the key will pass easily enough.

It is much quicker though (if a skeleton will not pass) to use a pick. These are made in various shapes; a few of which are shown in Fig. 2.

To open the lock shown in Fig. 1, it would be necessary to use two picks like A (Fig. 2), one to raise the tumbler, A, and another to throw back the bolt, B.

A locksmith or (I presume) a burglar always carries a bunch of skeleton keys and picks with him when he goes to pick a lock, and if the lock is a warded one, he never fails in opening it. We will suppose that a new key is required for the lock shown in Fig. 1. This is rather a difficult key to cut, and it will be better, if possible, to get a blank, with the bridge and collar wards also cut, as shown on dotted lines, Fig. 7.

If, however, he is unable to get anything better than a blank, he will have to cut these wards himself.

As I mentioned before, there are not so many wards in the lock as one would imagine by looking at the key; but we will suppose them to be there, and that it is necessary to cut the key as shown in the drawing.

If the reader has a small drill, it will be better to drill a hole at A (Fig. 4), and cut the L wards, B B first; if he has not, he must cut the bridge ward, C C, first. To do this he must make a straight cut with a warding file through C C. After cutting the bridge ward, he must lay the key on a flat surface (if there is an anvil or head on the vice, use that; if not, a flat iron held in the vice will do), and cut the L wards with a key chisel. Great care must be exercised in cutting these wards, or the key is liable to break at D D. The collar ward, E, must also be cut with a chisel. It is not necessary to cut the whole of the wards with a chisel, but only sufficient to allow the point of the warding file to enter. The two wards, F F, can easily be cut down with a file.

It frequently happens that the spring of a lock breaks. If it is a Scotch spring, as shown in Fig. 3, it can be purchased for about threepence; if a feather spring (G, Fig. 1), it will not be more than a penny. No directions need be given for fixing these, as the way they are put in is obvious to any one.

Should a new follower (C, Fig. 1) be required for this lock, it will have to be riveted in. To do this, it is necessary to take out the bolts, etc., and hold the face of the follower on the small head of the vice, if it has one, or on the face of a hammer held in the vice, and then rivet it on to the back of the vice. It must not be riveted on too tight, or it will not work. After riveting, it will probably require cleaning out with a small square file, or the knob spindle will not pass through. The price of a follower for a lock like this would be about three halfpence.

If the lock requires cleaning, all the movable parts must be taken out, and the case washed out with paraffin or benzoline; the bolts, staples, etc., must then be held in the vice and cleaned with emery cloth. Although not necessary, as far as the working of the lock is concerned, it is as well to clean the ledges of the case and the heads of the screws, as it gives a much better appearance to the lock. A drop of oil should be put on all parts where there is friction.

DOWELLED JOINTS.

ANOTHER PHASE OF "JOINTING UP."

BY DAVID ADAMSON.

For these the preparation of the edges must be the same as for plain joints, but, before going further, I ought to explain what dowels are. No doubt all who read these lines are familiar with them by name, but as dowels are invisible when work is at the stage in which it is most commonly seen outside the workshop, viz., when finished, it is quite possible that some may never have seen them, and may have very hazy ideas about them. Those who have access to an ordinary extending dining table may be referred to it as a familiar instance of the use of dowels. Open it, or look at one of the loose leaves. Little wooden pegs will be seen. These are dowels to all intents, but one end of them is unglued and merely fits tightly into a corresponding hole in the next leaf. In the dowel joint the dowel is fixed into both boards permanently with glue. Now with a fair notion of what a dowelled joint is, a clear start may be made to put its execution into practice. With a little attention it is not a difficult joint to make, always provided that the worker can plane up edges truly, but it may fairly be questioned whether there is any superior to it, either for strength or for speed of construction, as well as the number of situations in which it is available. We have, however, for the present only to consider it in jointing up boards for width, and we can hardly get a better example than by supposing two of the dining-table leaves glued together.

From the very nature of the dowel joint dowels are hardly ever used in wood under ¾ in. in thickness, but for anything above this they may be employed with advantage. The ordinary thickness of dowels is ⅜ in., but beyond this being a generally convenient size there is no special reason for it. It is, however, very important that whatever their thickness it should be the same as that of the bit with which the dowel holes are bored. The dowels must fit tightly in if they are to be of any use. Where they are used in large quantities, the dowels are bought ready made, or, rather, the lengths from which the dowels can be cut when wanted are got. They are not, however, any better than those which any one can make for himself, but are preferred because it is cheaper to buy them. Those who wish can, of course, buy them, but I do not think they are to be got in our smaller towns, and it will be just as well for the amateur to make his own. To enable him to do so a dowel plate will be required. It is merely a piece of iron, or better, steel, with a hole through it. This hole is bored clean and true, with square sharp edges. For occasional use a good serviceable dowel plate may be made out of a stout iron hinge flange. The screw-hole nearest the centre should be enlarged to ⅜ in. diameter, or just sufficient to pass the bit which will be used for boring the dowel holes. The plate thus prepared may then be screwed on to the bench, through which a hole must be bored at least as large as that in the plate, or to a piece of hard wood of, say, an inch or so in thickness. This latter is the more convenient of the two, as the plate can not only be put out of the way when not required, but a groove can be cut in the dowel while it is being formed. This groove is not invariably found in dowels, but there can be no doubt, for a reason which will be apparent later on, that it is advisable. It is not generally found in the bought machine-made dowels, from which, instead of it, a shaving should be taken off, or the dowel stuff passed through a block such as that about to be described, not all round, but enough to flatten it slightly at one part. In the block to which the plate is screwed a hole must be bored, as in the case of the plate being fastened to the bench. Through the thickness of the wood, say midway between the under and upper surface, insert a screw nail till the point just comes through into the hole sufficient to catch against anything fitting tightly into and passing through the hole in the plate. The plate is now ready, and may be used; but before attempting to do so, attention may be given to the dowel wood and its preparation.

Almost any straight-grained, strong wood will do for dowels, but beech and birch are those generally employed, though I do not know that they possess any qualities which may not be found in several other sorts. Waste pieces of any strong wood may be used instead of them. The pieces are cut into sticks roughly rounded, and then hammered through the dowel plate. This removes any irregularities, and the screw beneath it forms a rough kind of groove or furrow in the stick as it passes through. The length of the sticks is not of much consequence, but on account of the liability to breakage it is not convenient to have them more than nine to twelve inches, and they may be considerably shorter. I may as well say that the dowels to be effectual must be as dry as possible. If not, they will shrink, and not retain their proper hold on the wood in which they are inserted. Neglect of this precaution, and one or two other small matters, is, I take it, the reason why dowel joints are not altogether in favour in some quarters. When made carefully and intelligently, it is an open question

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whether they can be improved on by any other form.

With this, we may now dismiss the dowels themselves, and proceed to see how to use them. Now, it is quite evident that as the pin or dowel is inserted in two boards, half of it being in each, the holes bored for its reception must be exactly placed. To do this is not difficult. Presuming the boards have had their edges trued, place these side by side, and either hold them together in the bench screw or any other way that may be handy. Now with the square mark off across the edges of both at intervals of from 8 to 12 in.—more or less according to circumstances. If the boards are then placed edge to edge, it is clear that the lines on each must correspond with those on the other. Now, with the gauge set to about half the thickness of the wood, mark off a point on each of these lines. This point, of course, gives the centre of the hole to be bored in each. An ordinary centrebit may be used, but a twist bit is better, as it leaves a cleaner hole. In marking off with the gauge be careful to work from the same surface of the two boards, either from the face of both or from the back of both. Fixed, as they are supposed to be, in the bench, and then applied edge to edge, the necessity for this will at once be apparent, though, unless attention were directed, it might be overlooked.

Before preparing the edges it will be as well for the workman to look at the surfaces of the boards. Both may be equally good, but it will often be found that one side of a plank is better than the other, and it is just as well to let the better one be on the visible side. The dowel holes should be bored to a uniform depth of, say, one inch, and in practice it will generally be found better to bore them in pairs than to make them all in one plank before beginning with the other. To do this, of course, it is assumed that they are left in the bench screw and bored right off after marking. In order to get all the holes the same depth, a very simple contrivance may be used to prevent the bit boring further than necessary. Expert workers can do without it, but even they will often find it more reliable than guess work, sufficiently accurate though this may be. When I say that the little appliance suggested is merely the ordinary wooden stop so well known in the principal workshops, no further description can be necessary for the professional artisan. For the sake of the amateur, it may, however, be explained as being nothing more than a piece of wood with a hole bored through. The length of the wood—it is generally bored along the grain—must just be such that one end when the bit is passed through the hole will be against the stock, and from the other the length of the bit, equal to the required depth of the hole, will project. Those who do not care to take the trouble to make even this little arrangement may bore the holes fairly equal by noting the number of turns of the brace given to the first one, and making the others with the same. The mouth of the holes must then be widened with the rhymer or rose bit. This bevels them off at the edge, and not only facilitates the insertion of the dowels, but is useful for other reasons, which, however, need not be enlarged on. The rhymer must not be used too freely. One or two turns according to circumstances, in fact, barely more than necessary to remove the sharp edges, and any burr there may be from the bit used in boring the holes will be sufficient. By the way, as boring the holes has a tendency, more or less marked according to the wood and the kind of bit used, to raise the wood round the hole, it is sometimes advisable to run the plane over the edges again afterwards. This, of course, levels them, and though it may not always be necessary to do so, no harm can result from having recourse to it.

I said just now that the widening should not be too great, and it may be interesting to beginners and to amateurs as well to have their attention called to the reason. It is this :—The object of the dowel being to hold the boards together, it is important that as much as possible of the dowel should be in contact with the wood in which it is inserted. Now if the rhymer widens the hole to the depth of a quarter of an inch, that is, if the bevel formed by it commences at this distance from the surface of the wood, it must be evident that this space is waste so far as adherence of the dowel is concerned. Repeat this distance in the other plank, and we have at once a space of half an inch, which is practically wasted. Not of much consequence, perhaps, but, as I have more than once said, it is just by such small indications that the difference between the best and medium workmanship may be recognised. Too often one sees dowelling done in a careless manner, perhaps because the want of care is not so visible, nor attended with such disastrous results as it would be in some other operations. For similar reasons to those given for not widening the mouth of the hole too much, the dowel ought to go right to the bottom. If it does not, it is no unusual thing to see the surface of the wood joined plainly indicating the fault. There will be a hollow just above the empty space, especially when the wood is comparatively thin. It may be some time before this defect becomes apparent, but there is always a risk of it, a risk which should not be incurred, as it may easily be avoided by a little care.

In order to facilitate the dowel entering the hole, it is usual either to round off the entering end or to hammer its edges just sufficiently to make it slightly blunt. Both methods are practised, but the latter is to be preferred. If the end of the dowel is rounded by cutting or filing, of course some of the substance is removed, and in practice no bad results follow if the rounding is not too great. Mind, only the edge must be removed, and that it is neither advisable nor necessary to taper the pin, nor yet to make the end into a hemispherical shape. Perhaps this seems very similar to telling one how not to do it, so I may explain that the reason for calling special attention to improperly rounded dowels is because one frequently finds careless workmen shaping them so. Personally, I prefer hammering the ends. This removes none of the wood, but compresses the fibres, so that to all intents and purposes the end of the dowel is tapered off, but swells again under the action of the glue when it has been driven home, thus making a perfectly tight fit. Let us now suppose that two boards are to be fixed together. We take a piece of the dowel wood, whatever its length may be, and round one end with the hammer. Then glue the inside of the hole, though some adopt the somewhat speedier, but not so good, plan of dipping the end of the dowel in the glue pot. It is a slovenly way of doing, though, and it is better to glue the hole. In doing this, do not fill the hole with glue, nor yet put only a drop in, leaving the dowel to force it round. The best way to glue the hole is either to have a small brush with short end just about filling the hole—a suitable brush with short fibres can easily be made from a piece of cane—or to use merely a piece of stick a little less than the thickness of the dowel. This carries enough of the glue and disperses it easily in the hole. As quickly as convenient, so that the glue may not set before it is done, hammer the dowel home. The reason for the groove in this will now be apparent, for if there were no such channel there would be no means of escape for the glue, which will be forced down to the bottom by the dowel, nor yet for the imprisoned air. This latter might seem of small consequence, but it will be sufficient to say that if no allowance were made for it there is considerable risk of the board being split by it. Glue which may exude should not be allowed to set, or

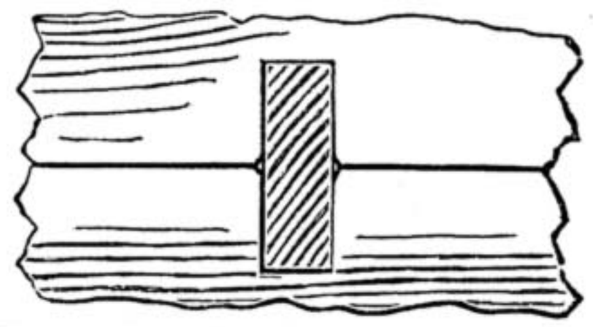

Fig. 1.—Dowelled Joint properly made.

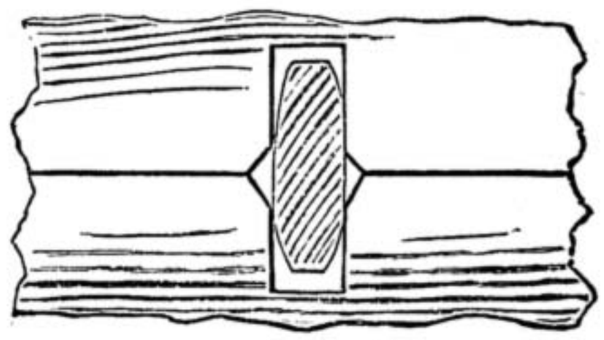

Fig. 2.—Dowelled Joint improperly made.

it would interfere with the close contact of the two boards. A small quantity will not matter if the joint is to be completed at once, and any there may be in the widened mouth of the hole may stop there. It can't do any harm even if it does no good. When the dowel is driven home saw it off, or rather saw off the excess, leaving the projection from the wood just the length of the corresponding hole in the other piece, or as nearly as possible so. In practice it is usual to cut a trifle short, for the obvious reason that if only a trifle too long the edges of the two boards could not come into close contact. All the holes are dowelled in the same manner in one of the boards, and the projecting ends rounded off by means of a file or a special dowel end rounder. Hammering naturally cannot always be so conveniently done on the second end. Perhaps some might like to know what the appliance for rounding the ends referred to is, but there is no sufficient reason for its description, as, unless a large quantity of dowels are to be trimmed off, a rasp will do just as well. I ought, perhaps, to insist on the necessity of the dowels being thoroughly dry before they are inserted, so that they will not shrink subsequently and, in so doing, lose their "grip." It now only remains to glue the edges of both pieces of wood, one of which, at least, should be warmed before doing so, and, of course, glue the holes which are not yet filled. All being ready, the boards are brought together and clamped up, when they should be left till the glue has set. Perhaps, by way of conclusion, the two illustrations may be given as a kind of summing up of all the foregoing. Fig. 1, given above, shows a properly-made dowelled joint, while Fig. 2 shows the joint, or, rather, the various faults which are most to be guarded against.

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SOME FORMS OF BITS AND DRILLS FOR THE LATHE.

THEIR USES AND HOW TO MAKE THEM.

BY OLLA PODRIDA.

The D-Bit, Rose-Bit, and Enlarging Drill.

When a number of similar holes or boxes have to be prepared, a considerable saving of time and cost is effected in the long run by making special tools for the purpose. To this the increased accuracy of the work must also be added, which in itself should compensate for any extra cost involved in the preparation of the tools. The writer proposes dealing with a few of the simpler forms of these, so that their construction and use may be made clear to those unfamiliar with the subject.

Commencing with the D-bit, this tool is peculiarly adapted for boring long or deep true holes of diameter too small to permit of their being bored by means of an ordinary bar or tool. Fig. 1 is an elevation, Fig. 2 a plan, and Fig. 3 an end view showing the cutting part. The general shape in section is semicircular, from whence the name of D-bit. The tool is made out of a piece of square steel, forged down to form the cutting part, at which end it should be, when forged in the rough, of the form given in Fig. 4, a small projection being formed in the middle to accommodate the lathe centre in turning. The material should also be worked up at the corners or sides as shown in Fig. 4, so as to permit of its being gauged or callipered to size. After being forged, the tool must be softened to permit of its being turned and filed up. The softening process is accomplished by heating the part to a cherry-red and burying it in fine ashes or quicklime until cool, when it may be manipulated with comparative ease. In the case of a half-round forging the turning can only be accomplished with the assistance of a slide rest. If, therefore, hand tools only are available, it will be necessary to forge the cutting end circular in section and form the flat part afterwards, and this in the case of a moderately large tool would be tedious. In turning the tool it is carried between the lathe centres in the usual way and driven through a carrier fixed on the square end. The turned part must be made nicely parallel and finished smoothly. The end may be roughly faced to assist and guide the act of filing up the front rake or clearance, as shown in Fig. 1. Not more than three or four degrees, rake or clearance should be given, as the tool works steadier the nearer the front cutting edge is kept square to the axis of the tool. This edge must also be slightly slanted or bevelled, as shown in Fig. 2, and whatever radius is given to the cutting corner, as shown in plan, must be slightly increased as the corner is followed round so as to make sure of its clearing itself. The top side must be filed down to the centre line, and this will be facilitated by drawing a line across the end for guidance. For cast iron and brass, the upper surface forming the cutting edge may be left straight, as shown by the full line in Fig. 1, but for wrought iron the cutting angle should be reduced by filing the relief shown by the dotted curve.

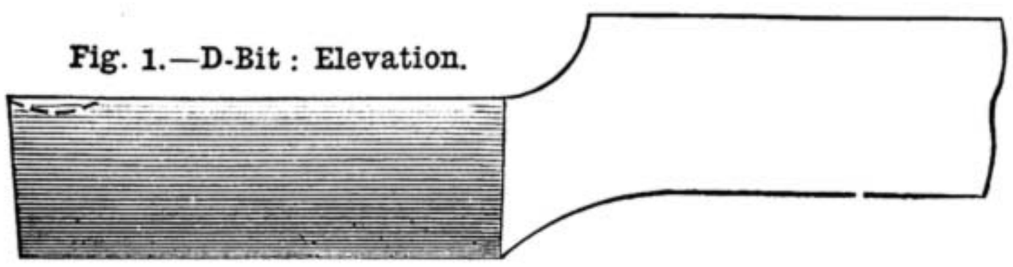

Fig. 1.—D-Bit: Elevation.

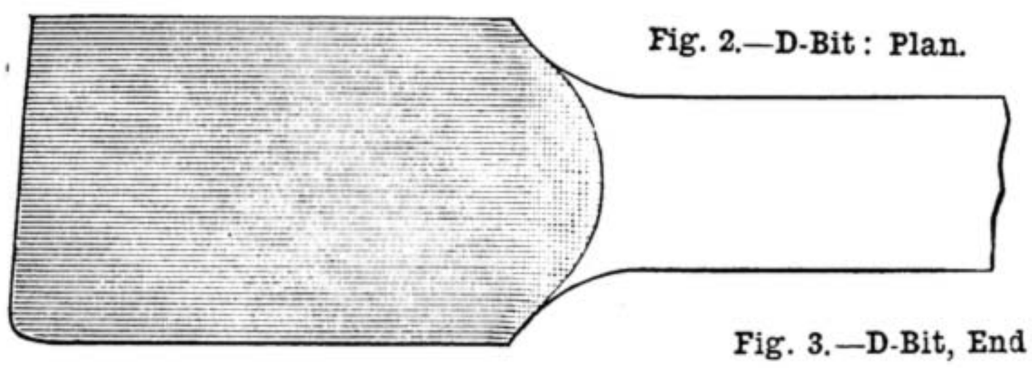

Fig. 2.—D-Bit: Plan.

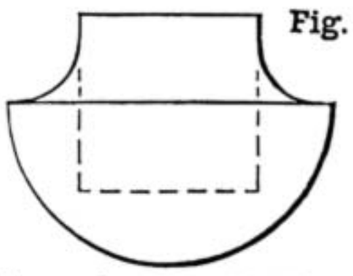

Fig. 4.—Working of Material.

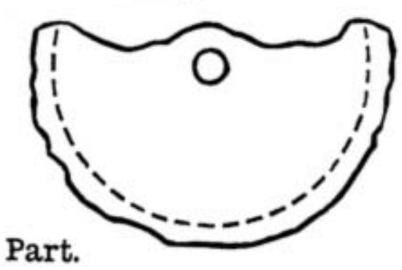

Fig. 3.—D-Bit, End View, showing Cutting Part.

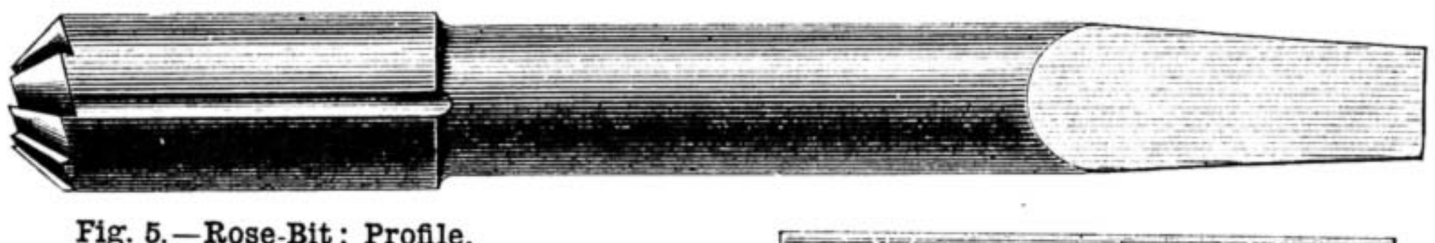

Fig. 5.—Rose-Bit: Profile.

Fig. 6.—Rose-Bit: End View.

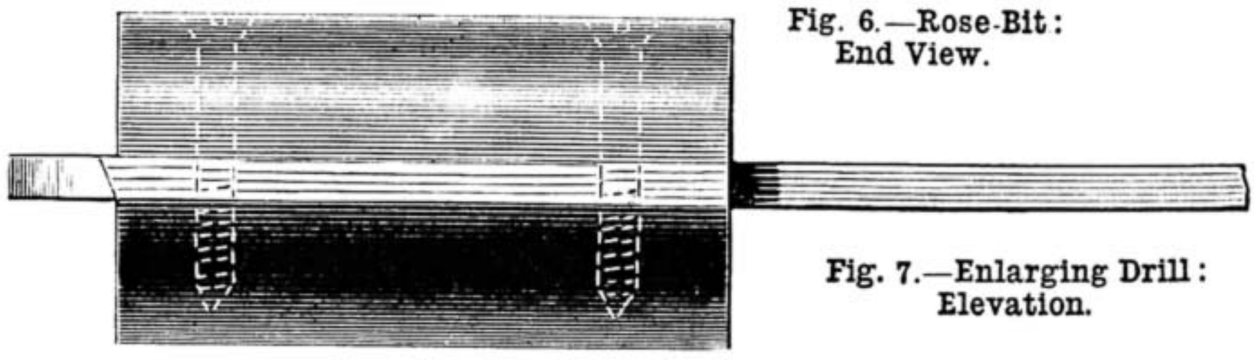

Fig. 7.—Enlarging Drill: Elevation.

Fig. 8.—Enlarging Drill: End View.

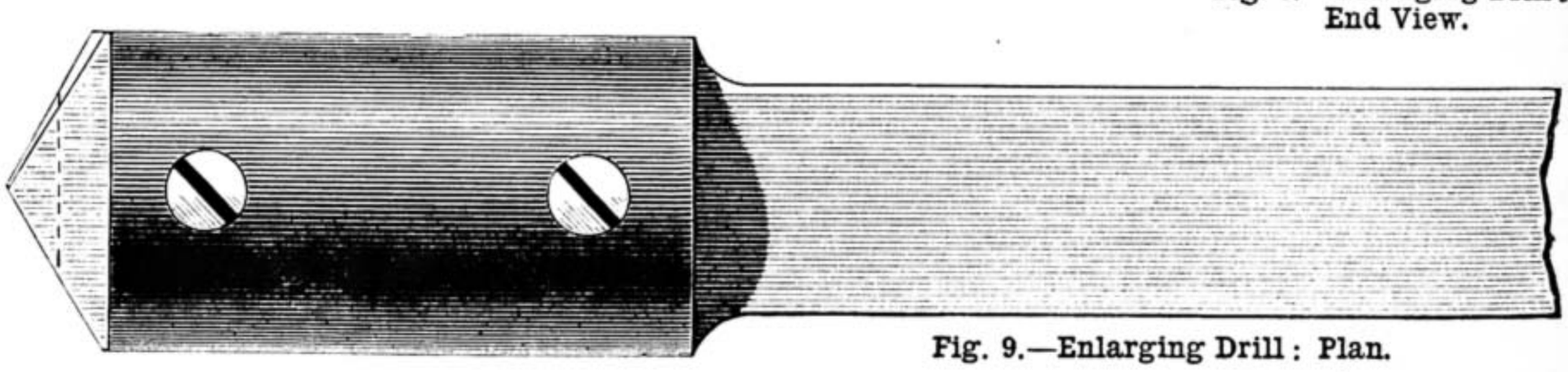

Fig. 9.—Enlarging Drill: Plan.

The tool having been carefully finished to size and requirements, it must be tempered. This is done by first heating the cutting end to a bright or cherry-red heat, and immersing it in lukewarm water to a depth of about one inch gradually, and then plunging it in bodily for a moment, withdrawing it and immediately brightening the end with a piece of sandstone so that the colours may be noted as the heat from the partially cooled shank spreads back to the end which was gradually immersed at first. The temper should vary according to the material to be operated upon. For brass and cast iron a dark brownish straw colour will stand well, but for iron or steel it should be somewhat softer—say purple, or dark blue tinged with red. Always remember that the lighter the straw colour the harder the tool, and as the blue tints become paler so the temper softens, making the tool more unfit for resisting fatigue. In any case, immediately the colour is reached the tool must be plunged into the water and finally cooled. If possible, use the tool while slightly warm, and if the material is hard it will stand better if used without grinding.

The method of using D-bits is as follows:—Suppose the work to be operated upon is set and fixed in the chuck, the first thing to be done is to bore a short distance at the mouth of the hole to the exact size of bit. A distance of about half an inch will be sufficient or just enough to cover the bevelling on cutting edge, and ensure a fair bearing for the bit to start upon. The tool should be held in the slide rest by the square shank, but it must be very carefully set to agree with the lathe centres. It may be used supported and fed or advanced by the poppet head, the centre in the end of shank being utilised for this purpose, and the tool kept from revolving under the pressure of the cut by means of a spanner held in the hand, or a carrier fixed on the shank and supported by the T or slide rest. In all cases the tool must be kept thoroughly well lubricated from start to finish, and this in small deep holes will be readily accomplished by the aid of a syringe or "squirt." Before leaving this form of bit, it should be noted that the turned half round part should never be less than two or three diameters in length, and it should never be allowed to become rusty or be otherwise neglected.

Fig. 5, the next in order, and Fig. 6 give profile and end view respectively of a very useful tool, specially adapted for accurate work or where interchangeability is necessary. It is not suited for heavy cutting, and is, therefore, chiefly employed for finishing holes which have been rough drilled or bored within a slight fraction of the finished size. The rose-bit, as this tool is commonly called, is better adapted for vertical work, such as in a drilling machine, than for the lathe, on account of the difficulty of lubricating it sufficiently while in a horizontal position.

The making of a tool of this description is a simple matter. It is only necessary to obtain a piece of steel of suitable size to allow for turning. The end may be tapered and squared, as shown in Fig. 5, to fit the spindle of drill if it should be required to use it in a dual capacity. This done, and the material softened all over, according to the directions given above for the D-bit, it must be turned up to the required size and

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made just easy to the callipers or gauge. The gauge part, which is cleared to the shank by a shoulder, must be made quite parallel; in fact, it is safer to make the cutting end a shade larger than the other end of the gauge part to ensure against jamming. The conical part, out of which the teeth are formed, must also be turned, and the centres should be left in both ends of the tool for future convenience. The grooves shown running along the gauge part are for lubrication, and may be conveniently cut in the lathe by fixing a round-nosed tool on its side in the slide rest, and traversing the rest or saddle by hand. The teeth are formed by filing, and care must be taken that they are all truly cut to the cone. The square taper part must be well fitted to the drill spindle, as nothing injures a socket more than a badly-fitting shank. For such turned tools as this, the square should be preferably replaced by a turned taper secured by a key or setscrew; it is a matter of difficulty to get a square driven bit to run true. The tempering of this tool may be carried out exactly as described for the D-bit. All scale must be cleared off, and the bit polished after tempering to secure a smooth hole. It must not be used at a high speed, especially for deep holes where expansion from heat might prove troublesome. When this tool is used in a lathe, it is held as described in the last case of the D-bit, namely, by means of the poppet head.

A very handy and cheaply made form of drill is that given in Figs. 7, 8, and 9, being elevation, end view, and plan respectively. It is more suitable for enlarging holes which have already been bored, but it is a serviceable substitute for the more expensive D-bit. This tool consists of a piece of flat steel of suitable length and thickness, the latter being proportionate to the width or diameter of hole, say about one-fourth of the width. The cutting end is formed like a common drill, but it need not be brought to a point; the dotted line would give enough cutting edge. The tool is turned on the edges for a portion of its length, and pieces of hard wood fastened on each side, and also turned to the size of hole required. The duty of the wood is to keep the drill central and steady while cutting. These pieces are secured by screws passing through the bit as shown. Where a heavy cut has to be carried, it may be necessary to cut clearance for the chips through the wood; but this is very detrimental to the latter, and it is therefore better to withdraw the tool and clean out the hole at intervals. This tool is held up to its work in the manner described for the D-bit. The procedure of tempering is also precisely similar, except that it should not be made quite so hard on account of its being thin, thereby rendering the corners liable to give under a heavy or sudden cut. The centres should be left in the ends of this tool to facilitate the mounting of fresh wood packing from time to time.

The tools described above will be found extremely useful, and no metal worker will experience much difficulty in making them. This, of course, is said chiefly for the encouragement of amateurs, as all professional workmen are well accustomed to manufacture special tools to meet the exigencies of certain special work that frequently demands their attention. Indeed, even when a tool suitable for the work in hand may be purchased, it has been found to save time to make the tool rather than to waste it in waiting until the purchased tool has been brought or sent home according to order.

WROUGHT IRON AND STEEL GIRDER WORK.

BY FRANCIS CAMPIN, C.E.

FITTING AND ERECTING—PLATE AND ANGLE IRON JOINTS—RIVETS AND RIVETTING.

THE material having passed through the general processes already described, the next stage is fitting and erecting. This may be for temporary or for permanent purposes, the former applying to large work which is first put up and tested, and then taken down again for shipment abroad; the latter course being adopted for home work, for the

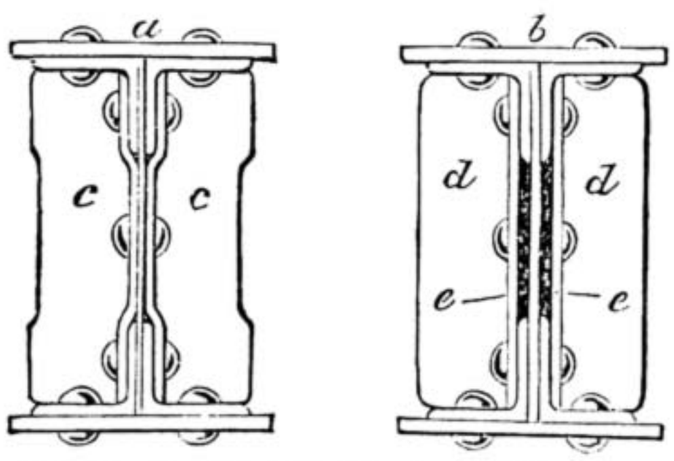

Fig. 9.—Joggled and Packed Stiffeners.

execution of which, if of sufficient magnitude, workshops are frequently erected adjoining the site of the proposed structure. It sometimes occurs that a considerable number of girders of one pattern are required for foreign and colonial railways, and in such cases it is desirable to have the parts interchangeable, as this is a great convenience in re-erecting; and in such cases the great advantage of pressing, over hand smithing, angle iron knees, and similar details, becomes manifest.

The staging upon which the girder is to be erected must be made with the proper camber, usually a central rise of one inch for every forty feet of span, which is given in order that, under its full load, the girder shall not deflect below the horizontal line connecting its extremities. This allowance

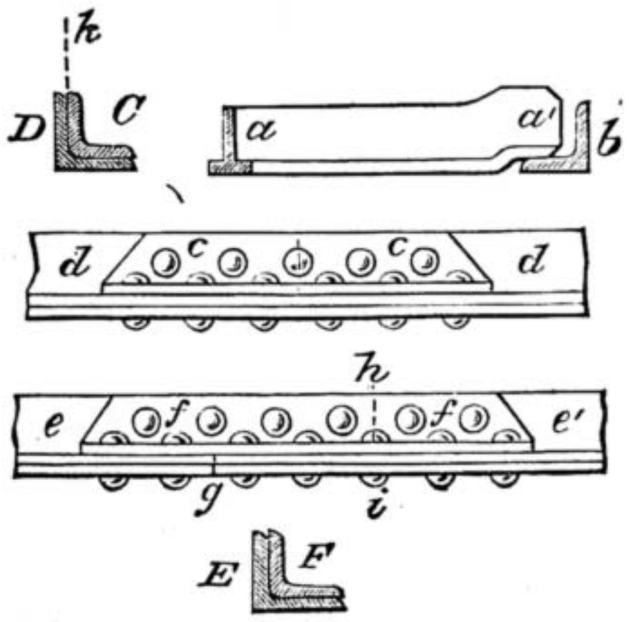

Fig. 10.—Angle and T Joints.

is ample, as it is generally considered that in well-designed and properly-constructed girder work the deflection under a full load should not exceed one inch in every hundred feet of span.

I should feel inclined to lay especial stress upon the necessity of employing great care and very experienced hands in the fitting and erecting department but for the fear of detracting from the importance of the preceding manipulations, and they are really all of such character that negligence is not to be risked in any branch of the work, otherwise it will not be brought to a satisfactory completion. The erection of the structure is always a test of the accuracy with which the material has been prepared. and will be straightforward work if the templates have been properly made and accurately worked to, but, otherwise, it will be involved in much trouble and difficulty. At this stage, too, will the character of the joints become evident, and show whether the details have been properly considered.

When the girders are built up before rivetting, the parts are held together by bolts called service bolts, of which a sufficient quantity is used, passing through the rivet holes, to hold all the parts in close contact. The plates, having been properly planed, should come together without any trimming, but the ends of angle bars may require some chipping to make good joints, and the knees, if hand-smithed, may require easing off at some of the bends. In some instances, the emery wheel may be found a useful adjunct in this work. All knees, stiffeners, angle pieces, and gussets should be made to fit truly, as upon them the general squareness and freedom from twist and winding will depend. If it is found that any piece falls short of the surface it should touch, it should be thrown aside, and not worked in by the aid of packing, which should never be used unless it is a part of the design. Packings, generally speaking, are to be avoided as much as possible; they add to the weight without increasing the strength of the girder, and impair the solidity of the work; but in some cases it is convenient to use them to avoid joggles. As shown in the sections Fig. 9, *a* and *b* are cross sections of plate girders stiffened by T irons, *c*, *c*, in one case, and *d*, *d*, in the other. The T irons, *c*, *c*, are shown joggled over the angle irons. When the girder is of considerable depth there is no inconvenience in this; but in shallow girders the joggles come very close together, and neater work may be secured by using packings as shown at *e*, *e*, of thickness equal to that of the angle iron. Unless the girders are more than fifteen inches deep it will be best to use packings.

It sometimes happens that errors occur in the shop which may be made good without wasting material, but where this involves any alteration in the construction, however slight, it will be necessary to obtain permission of the engineer in charge of the work to make it, hence this course will only be pursued when the quantity of material at stake is considerable. A mistake of this kind came under my own cognisance some years since: the flange plates of a heavy plate girder (108 ft. long by 8 ft. deep and 2 ft. 6 in. wide) were planed too short; in fact, through a change of foremen the plate ends were planed twice, and, therefore, when erected, failed to meet by half an inch. In the bottom flange, where the joints are in tension, this gap would not signify so far as strength is concerned; but in the top flange, which is in compression, it is highly important that the joints should butt fairly together. In this case steel wedges were made with a very slight taper to fit the spaces between the plate ends, and solidly driven in. The result was highly satisfactory, and the bridge, when tested, showed a higher degree of stiffness than is usual in such structures.

In the case just referred to, there could be no doubt that the joints did in reality butt, but in the ordinary run of work it is impossible to find out, after rivetting up, whether the plate ends are in contact or not throughout their width, and that is why in English practice compression joints are made with a full complement of rivets sufficient to carry the whole strain from one

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main plate to the next, but every care should be taken to make all joints, in whatever position, butt as truly as possible, in order that the girder may not become distorted during rivetting, and also to assure solid work. To this end, also, all the parts should be drawn together to true bearing by the rivets to avoid the occurrence of unnecessary cross strain. When a plate girder is completely riveted up, and supported through its whole length on the erecting stage, it is evident there ought to be no strain upon any part of it of a transverse character, but if the details do not fit together properly, all sorts of strains may be set up by the contraction of the rivets in cooling.

In Fig. 10 are shown some angle and T iron joints. *a a'* is an elevation of the end of T iron stiffener which beds upon an angle iron, *b*, shown in section. The end, *a'*, which is removed a little from the angle iron, *b*, that its form may be clearly seen, is shaped to fit the curve in the root of the angle iron against which it bears, so that the rivet may bring the two solidly together; ends such as this may be chipped to form, and smoothed off when necessary on an emery wheel.

Angle iron joints are usually made square as shown by the ends of the bar, *d*, *d*, which are butted and joined by the angle iron cover *c*, *c*, the joint of the angle irons being indicated by the dotted lines. *D* and *C* are the main and cover angle irons shown in section; the cover is rolled with a round back, which fits close into the root of the main angle bar. It is, of course, necessary that, if the full strength of the angle iron is to be carried through the joint, the sectional area of the angle cover shall be equal to that of the main angle iron, and, therefore, as it measures less upon the sides its thickness must be greater; thus, if the main bar is 3½ in. by 3½ in. by ½ in. thick, its sectional area is 3¼ square in. thick. The cover bar for its edges to lie flush with those of the main bar will be 3 in. by 3 in. on the sides, and, therefore, to have a sectional area of 3¼ square in. must be ⅝ in. thick. This gives an excess to the cover, but it is the nearest size commercially obtainable above that found by calculation. This additional thickness sometimes causes a difficulty with the rivets. Setting out the rivet centres, as described in No. 8, p. 117, those in the section *D* will be 1½ in. from the surface, *k*, of the main angle iron, and deducting ⅝ in., only ⅞ in. from the inside of the cover, *C*; this is very little room to make up the head of a ¾-in. rivet in. With the view of using thinner covers, the angle joints may be placed where from necessity the strength of the main angle irons is in excess, and thus greater facility for good and neat workmanship will be given. It is, of course, impossible, practically, to make the section of the girder in exact proportion to the strain at every point in the length; the excess in the flanges of a well-designed plate girder, including cover plates, amounts to 10 or 11 per cent. of the theoretical weight. This excess necessarily existing, it should be taken advantage of wherever opportunity occurs so to do.

The next sketch shows a more complicated angle joint, which I once encountered in some colonial work. It is certainly a very bad form, about as bad as can be, but it was insisted upon and accordingly worked to. *f*, *f*, is the cover plate, the only peculiarity of which is that it is much longer than is necessary when the ordinary joints are used. The end, *e*, of one bar is cut off square at *h i*, and then has its horizontal table cut away from *g* to *i*; in like manner the end, *e'*, is cut off square at *g*, and the vertical limb cut away from *g* to *h*. Between *g* and *i* the contact of the angle bars is the same as in a mitre joint. *E*, *F*, show a section of this joint, and it will be seen that from *g* to *i* the root of the angle iron is cut through, so that, regarded as an angle iron, all strength is gone from the main bar, and its duties are transferred to the cover, *f*, which, being further off the work connected, is less efficient in securing its solidity. There is no compensating advantage in this arrangement, and the metal cut away is wasted.

The ends of bars and the joints having been properly fitted, the work is to be firmly secured in position by the service bolts, which should fit the rivet holes with sufficient accuracy to ensure that of the positions of the different component parts, which will then be ready for rivetting up. Sometimes bolts with cotters are used to hold the work together, but this is a practice to be discouraged, as cotters are never so reliable as nuts.

We now come to the rivetting of the girder together, and, in order to appreciate the care required in the conduct of this operation, it is necessary to consider the duties of the rivets and the way in which they are carried out. Some engineers allow a considerable percentage of rivets for defective work, but this should certainly not be necessary, especially if the manufacture is properly inspected by a competent and honest official appointed for that purpose.

The strain upon the rivets may tend to cut them across, or to pull the heads off, and in any case there is this latter tendency during the period of their cooling after the heads are made, so that in any case the rivets should be so proportioned that they are at least as strong to resist the heads being stripped off as to withstand tearing asunder through the body. The working strength for iron rivets in tension is five tons per square inch of sectional area taken square to the length. The cross sectional area is equal to the circumference multiplied by the diameter divided by four, and the circumference is equal to the diameter multiplied by 3⅐, therefore the resistance to tearing across is equal to the square of the diameter in inches multiplied by four very nearly, this giving the working load in tons with sufficient accuracy for practical purposes. The resistance to pulling the centre of the rivet out of the head is four tons per square inch of the surface stripped, and that surface is equal to the circumference of the body of the rivet multiplied by the thickness of the head in line with the body; therefore the working resistance to stripping is equal to the diameter of the body multiplied by 3⅐ and by four times the thickness of the head, and this must be equal to the resistance to tearing—four times the square of the diameter; therefore the thickness of the rivet head must not be less than the diameter multiplied by 7 and divided by 22, or, as a practical rule, the thickness of the head must not be less than one-third of the diameter of the body of the rivet.

The action of the rivets in drawing the plates together in cooling will cause such frictional resistance to their sliding one upon another as very materially to aid in the strength of the joints, but, as the amount of such resistance is not accurately ascertainable, it is not relied upon, but goes as margin. Its outside value, taking the friction of the plates to be one-fourth of the pressure pressing them together, in tons, will be twice the total sectional area in square inches of all the rivets in the joint, as the pressure due to the rivets cannot exceed the elastic limit of the metal, which is about eight tons per sectional square inch, and it probably is much less.

The rivetting up is almost exclusively done now by hydraulic riveters, hand rivetting only being resorted to where the hydraulics cannot be brought to bear. It is much better, as the rivets are more quickly closed, and the jarring effects of the hammering are not brought upon the work, and this must, where it occurs, tend to derange the positions of the parts put together with service bolts. As it is obvious that the rivet will expand when heated, the rivet rod used in their manufacture must be somewhat less than the rivet holes, which are made the size of the finished diameter of the rivet. One-sixteenth of an inch is usually allowed; so rivets that finish three-quarter inch are made from $\frac{11}{16}$ rod. The rivets are supplied with one head made, and there should in their length under the head be allowed, in addition to the thickness of plates passed through, 1½ diameters to make the other head, which is formed by a die called a snap fixed in the jaw of the rivetting machine; or in hand rivetting held by an assistant on the rivet end after the head has been roughly knocked up by the hammers. Plenty should be allowed for the rivet head, and should it be a little in excess and form a collar round the base of the head, it should not be cut off for fear of damaging the plate beneath.

BASINS, BATHS, AND BATTERIES.

BY GEORGE EDWINSON BONNEY.

Barium—Barium Chloride—Barium Sulphide—Barometer Scales—Basins—Bath—Bath Brick—Batteries.

Barium.—Chemical symbol Ba. Combining weight 137. A mineral found in heavy spar and witherite. It combines with oxygen, chlorine, and sulphur to form various salts, only two of which are of interest to us here.

Barium Chloride.—$Ba.Cl._2$. Is prepared by dissolving witherite (Barium Carbonate) in hydrochloric acid. Its solution is used to detect the presence of sulphuric acid and sulphates in solution. These decompose barium chloride, and the free sulphuric acid unites with barium to form sulphate of barium, which falls as a white crystalline precipitate insoluble in water and in dilute acids.

Barium Sulphide.—Ba.S. This salt has been employed by Mr. A. Watt to give a warm bronze tint to clean copper articles. The solution employed was made with four or five grains of this salt to each fluid ounce of water. The articles to be bronzed are immersed in the solution, and allowed to remain in it until they acquire the desired tint. All the salts and solutions of barium are more or less poisonous.

Barometer Scales.—These, together with thermometer scales, and the metal dials of clocks, are silvered by the simple silvering process, or silvering by simple immersion. See notes on *Silvering by simple immersion*, *Whitening Clock Faces*, etc.

Basins.—Porcelain basins are handy adjuncts to the plater's plant of tools. Small quantities of solution for experiments can be readily made up and used in them with safety. They can also be safely used as dippers in dipping out solutions of all kinds

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from cisterns and vats. Earthenware glazed basins of the common sorts cannot be trusted to hold acids or strong solutions of salts for any given time, as the glazing soon gives way, and the ware is then speedily pierced by the solution. Acid-proof stoneware bowls and basins can be obtained from Messrs. Doulton, Lambeth Potteries, London.

Bath.—This name is applied by electro-platers to all solutions used in the workshop in which articles are immersed to be cleaned or to be plated. It is also meant to cover the name of a solution and the vessel in which it is contained ; hence, when we hear a plater speak of his gold or silver baths, it means the vats and their solutions as they stand. In this series of notes, the various "baths" will receive attention under the several heads of *Gilding Solutions*, *Plating Solutions*, *Pickling Solutions*, *Dipping Solutions*, etc. See also notes on *Copper*, *Gold*, *Nickel*, *Silver*, etc. The various vessels to contain the solutions will be described under the note headed *Vats*.

Bath Brick.—Finely-powdered and sifted bath brick is used in cleaning the surfaces of articles intended to be left "dead" or "frosted." It is not suited for the preparation of articles intended to have a smooth surface when finished, except as a first scouring material to be followed by more finely abrading powders. The powdered bath brick should be used dry, and brushed over the surface of the articles whilst these are being held in a scouring tray.

Batteries.—The word battery, as applied to electrical apparatus, belongs strictly to a collection of Leyden jars charged with static electricity. These discharge their store of force in a violent manner, totally unlike the equable flow of current obtained from collections of voltaic or galvanic cells. French electricians speak and write of such generators under the name of "Piles," doubtless in deference to the form of the first voltaic generator of electricity made—the pile of metal discs invented by Volta. English electricians apply the word battery to all apparatus in which electricity is generated by chemical decomposition, and also to those forms of storage cells known as accumulators and Leyden jars.

A list of the batteries in use by electro-platers is given in the annexed table, which will also show at a glance those most suitable to the work to be done.

The Fuller might be added to this list, but should even then be regarded as a make-shift should none other be available. The Wollaston is also used in some workshops. Each battery has its own peculiar characteristic which renders it fit or unfit for the work to be done. Thus, the Bunsen battery, as ordinarily constructed, is the best for nickel-plating and copper-plating in alkaline solutions, because its electro-motive force is high, enabling the current to push through high resistances. But even then we must not use small cells except we are doing small work, that is, plating a small number of small articles. This battery, however, is not suitable for the work of silver-plating, gilding, and electrotyping, because its high E.M.F. causes the metal to go on too fast and in a granular condition. In all these operations the Daniell will be found to be the best because its E.M.F. is lower than that of the Bunsen, and its current equally constant in volume. The Smee, and also Walker, are eminently useful cells for giving a current suitable to the work of electro-gilding small articles of jewellery. Batteries with a high E.M.F. cause gold to go on too fast, and give the deposit a high colour. The French gilders and platers make up the Bunsen with sulphuric acid in the porous cell with the carbon, and thus get a constant generator with a lower E.M.F. This form is also less troublesome to keep in working order than the ordinary Bunsen, and it has the merit of being free from noxious fumes. Nearly all the batteries given in the list may be altered and modified to suit the wants or conveniences of the operator. A modification of the Bunsen has just been noticed. It may also be noted in the table of batteries, that I give various strengths of acid solutions to be used in the zinc compartments of the batteries. These suggest other most important modifications, the E.M.F. of the battery varying with the quantity of acid used. For instance, the E.M.F. of the Bunsen charged with a solution of one part sulphuric acid to eight parts of water may give an E.M.F. of 1·95 volts, but when charged with a solution of one part sulphuric acid to 10 or 12 parts of water the E.M.F. may fall to even less than 1·80 volts. The Daniell, Smee, and Walker may be modified in like manner. Mr Smee, in writing about his own battery, says :—

"The liquid generally adopted to excite this battery is a mixture of one part by measure of sulphuric acid and seven of water, which will be found amply strong for all purposes. The electro-metallurgist will frequently find it advisable to use dilute sulphuric acid, only containing from $\frac{1}{10}$th to $\frac{1}{16}$th of the pure acid, and adding some acid when the first is exhausted ; taking care, however, that the quantity of acid never exceeds the $\frac{1}{4}$th of the original water, for any excess above that quantity will be useless, as the liquid will then become saturated with the sulphate of zinc." Still further modifications may be made in the battery by enlarging or diminishing the size of the negative or the positive element, or both of these, and in altering the size of cell containing them. As a rule, the enlargement of elements and cells tends to an increased output of current, because the internal resistance of the battery is lowered, and there is, consequently, more available force for the outer circuit. Enlarging the negative element will frequently bring about the desired result of lowering the internal resistance of the battery and increasing its volume of current. This is specially noticed in the Daniell, Smee, and Walker batteries.

Large cells (holding from one to 10 gallons each), and large elements to suit them, become a necessity when articles of a large size have to be plated, or when a large number of articles have to be plated at the same time. This necessity may be partly met by employing a great number of small cells coupled in multiple arc, but small cells thus coupled up soon run down, because, being placed on short circuit, their charges of acid soon get used up. The best work is generally obtained when the elements of the battery present a slightly larger surface to the liquids within the battery than that of the anodes to the solution in the vat.

Lastly, the current obtainable from a battery may be modified by the manner in which the cells are coupled together. If the E.M.F. is too low, we may couple the cells up in series until the required E.M.F. has been obtained ; or, on the other hand, if the E.M.F. is too high, we may take off cells and thus reduce it. It is never good practice to couple two or more cells of a different style of battery together to obtain the needed E.M.F., as the weak cells always pull down the current to their own level, and the current from the stronger cells will heat the solutions in the weakest, thus impairing the efficiency of the battery.

TABLE OF BATTERIES USED BY ELECTRO-PLATERS.

Name of Battery.	Negative Element and Solution.	Positive Element and Solution.	E.M.F. of Cell.	Approximate Resistance of each Cell.	Work for which it is most Suited.
Daniell.	Copper in saturated solution of sulphate of copper.	Zinc in sulphuric acid solution, 1 to 12 or 15.	1·079 volts.	2 to 5 ohms.	Electro-gilding, silver-plating, and electrotyping.
Smee.	Platinised silver in dilute sulphuric acid, 1 to 10, 15, or 20.	Zinc in dilute sulphuric acid, 1 to 10, 15, or 20.	0·47 volts.	0·5 ohms.	Electro-gilding, silver-plating, and electrotyping.
Walker.	Platinised carbon in dilute sulphuric acid, 1 to 10, 15, or 20.	Zinc in dilute sulphuric acid, 1 to 10, 15, or 20.	0·66 volts.	0·4 ohms.	Electro-gilding, silver-plating, and electrotyping.
Bunsen.	Carbon in nitric acid.	Zinc in sulphuric acid solution, 1 to 15 or 20.	1·7 volts.	0·8 to 0·11 ohms.	Nickel-plating and copper-plating in alkaline solutions.
French Bunsen.	Carbon in strong sulphuric acid.	Zinc in sulphuric acid solution, 1 to 15 or 20.	1·6 volts.	0·11 ohms.	Electro-gilding, silver-plating, copper-plating in alkaline solutions, and nickel-plating.

Batteries for electro-deposition are fast giving place to dynamo-electric machines, the current from these being in every respect more suitable to the work of depositing metals than that from the best batteries. They are also more cleanly in working, less costly, and more easily managed. See notes on *Dynamo-electric Machines*. For information on amalgamating the zincs of batteries, see notes on *Amalgamation*, *Zinc*, *Mercury*, etc. For information on how to connect cells together, see notes on *Binding Screws*, *Clamps*, and *Connections*. See also notes on *Bunsen Battery*, *Daniell Battery*, *Smee Battery*, *Walker Battery*, *Wollaston Battery*, etc.

A TRAY FOR LOOSE LETTERS, WITH INK-BOTTLE.

BY E. BONNEY STEYNE.

THE penny post is, of course, a big blessing, and although in England, the home of its birth, we are yet not so thoroughly well served, at once so cheaply and expeditiously, as, say, Belgium, for example, yet a good many of us get even more letters than we want. Now the future storage of these is not an easy matter, if they are to be at once tidily put away, and yet available for immediate reference.

There is a very true proverb that says if

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you want a thing done, the most busy man of your acquaintance is more likely to do it than the laziest; and, in similar fashion, the man who has dozens, or it may be a number reaching at times to hundreds, of letters daily, is tolerably sure to have some system in force. But the average private correspondent is reduced to a survey of his wardrobe and to start an expedition as amateur pocket-picker on his own coats (or dresses, if it be a she, hanging up like Bluebeard's wives). Such a way is, however, more suggestive of a student of the Jew Fagin's academy than a respectable letter writer, who finds suddenly an important address, or a question needing reply, has escaped his memory, and lies dormant in some mislaid missive.

The first few minutes after reading a letter is generally the crucial time for its future chance of existence in a definite locality, and the majority of those received must needs be immediately disposed of; yet while, of course, a certain class of correspondence is never open to public perusal, save in the deplorable event of an action for breach of promise, there are a great many purely formal ones that are in no way "private and confidential," which may be at once placed on the writing table for consideration at a convenient season.

But a writing table specially set aside, with needful appointments, is not in every room of a middle-class house. In fact, the presence of such a table for real workaday use, and not merely of the "elegant davenport" order, is a sure sign that the household has intellectual tastes, or is intimate with the usages of what the old novelists called "polite" society.

For the ordinary house, or bachelor's apartments, a tray to contain invitations, business letters of no great importance, and the usual missives awaiting reply, is a great advance upon the frame of the looking-glass, or the hundred and one odd corners where such things are banished.

If this tray has an inkstand and receptacle for pen-holders, sealing-wax, etc., it is doubly useful, for then it converts any table into a writing table for the time being when placed upon it.

Such an one is shown in the design now given. Fretwork has been selected for its ornamentation, because it is the most available method for many who like to make useful little additions to their surroundings, or suitable presents to their friends. But the

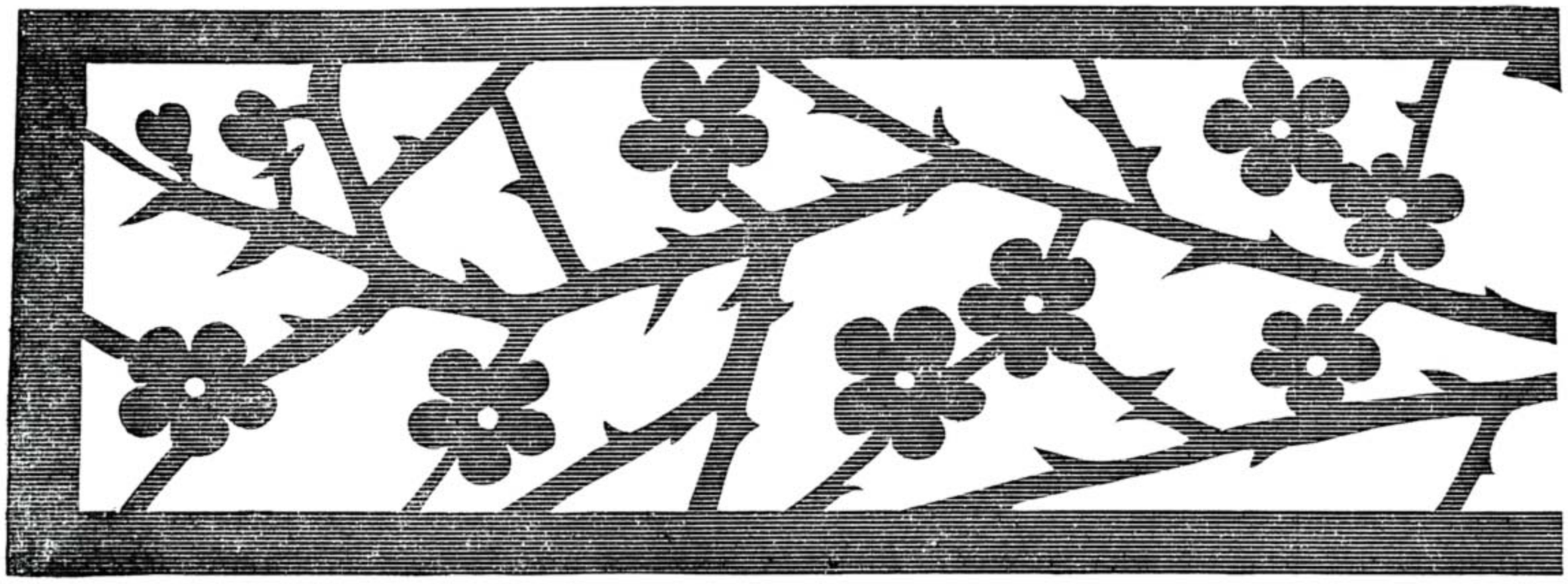

Fig. 2.—Left-hand Part of Side of Paper Tray—Cut Two; A, B, C, D show Points of Connection with Fig. 2a.

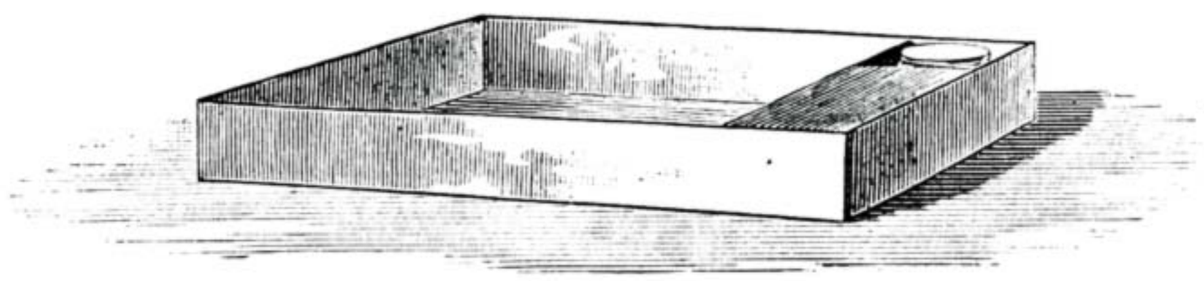

Fig. 1.—Rough Design of Paper Tray Fitted for Use as Inkstand.

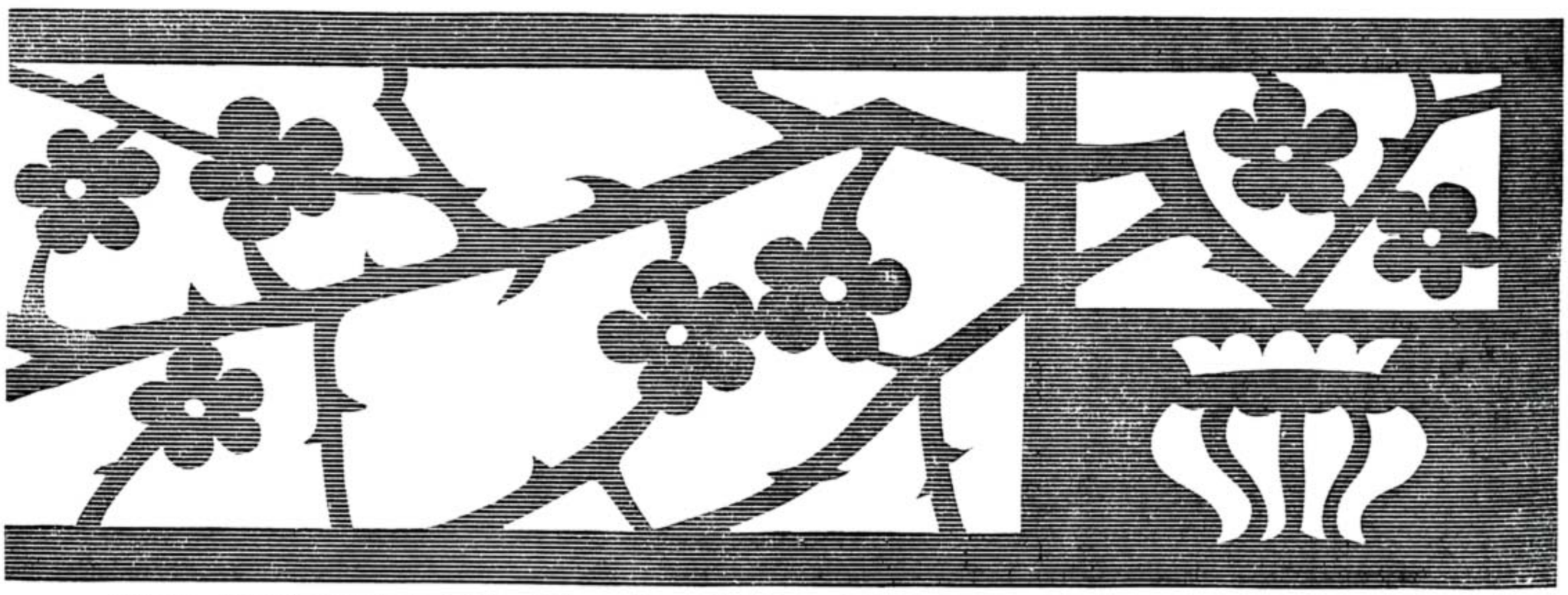

Fig. 2a.—Right-hand Part of Side of Paper Tray—Cut Two; A, B, C, D show Parts of Connection with Fig. 2.

idea is often to be seen in shop windows, made in leather and various other materials.

The baskets so largely used for MSS. are, no doubt, the same things practically, but the addition of an ink-bottle makes this more convenient for private use.

The wood should be polished each side, unless, as in the case of oak, it is left entirely plain. Bearing in mind the foregone certainty of blots near an inkstand, it would be best to stain the wood with ebony stain before polishing, using the proper French polish for black finish.

In such work as this, it is best to fit all the pieces together with neatly dovetailed or tongued joints, as the skill of the worker is able to command, before the actual sawing of the design is undertaken. See also that the wood is brought to a fine, smooth surface before pasting on the design, as after use of sand paper is apt to dull the sharp outline of the fret cut line. The bottom of the tray should be lined outside with cloth or baize; inside with leather Japanese gold paper, or some other substance, to give it a finished appearance.

As small covers, if left loose, are generally lost or broken long before the article to which they belong is worn out, it would be as well to hinge the lid to the pen-holder compartment—which plan keeps that receptacle free of dust, a distinct gain to the majority of careless writers who do not wipe their pens after use.

The given size, 12 by $8\frac{3}{4}$, is fairly useful, but enlarged to about 15 by 12 it is more so, as then the compartment for papers admits quarto and cut foolscap, and the pen division takes full-sized holders. But for private use the size shown is, perhaps, large enough.

Such a thing ought to sell well at bazaars, or be a most acceptable present to any adult. It is easy to construct, and displays all the work expended upon it well in sight, an important item to the amateur, who naturally likes his labour to yield its full effect. With little more work in its construction than an ordinary fret-sawn bracket or photograph frame, it may claim to be of really practical use, and form a thing with reason for existence evident and provable.

Some parts of the designs, it will be noticed, are shown in black on white, while others are the reverse. This is not a merely fanciful alteration to give variety to their ornament, but has a practical reason. Figs. 1 and 4 are for the end that provides receptacles for the ink-bottle and for pen-holders. Fig. 1, it must be noted, is worked in

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duplicate, since it supplies the end pieces of the tray and the division between the part to take loose papers and the other. Note also that Figs. 2 and 2a (really one piece divided for mechanical reasons imposed by the necessities of space) must be traced twice and cut in reverse. That is to say, the right hand end of the one piece must be the left-hand portion of the other. Then the solid part of the design explains itself, for all those parts enclosing the bottles and holders are treated in this fashion to exclude dust, so far as is possible in fretwork. Fig. 4 is the cover for the pen-holder compartment, intended to be hinged to the division piece, Fig. 1. A piece of plain wood to partition off the ink-bottle space is, of course, also needed, likewise a piece to catch the lid as in ordinary boxes. It is easy to say all these petty details should be apparent to the meanest intelligence; but taking my own as the average—the very mean average—I feel that the extreme difficulty of explaining these things briefly, yet clearly, is yet not so appalling as the labour of translating such attempts into actual handiwork, for words are at best variable things.

Here I must leave the further consideration of the designs to each reader, who must determine for himself whether or not he will take them in hand. I will content myself with suggesting that the patterns may be so adapted and manipulated as to make glove and handkerchief boxes, which will be both pretty and useful.

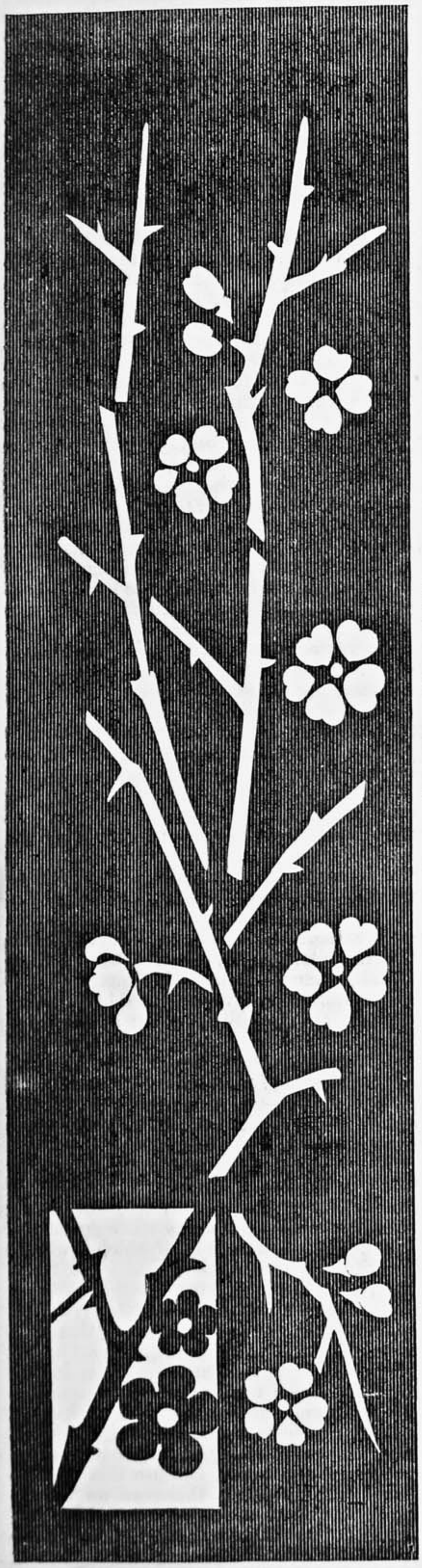

Fig. 3.—Inkstand End and Division of Tray—Cut Two.

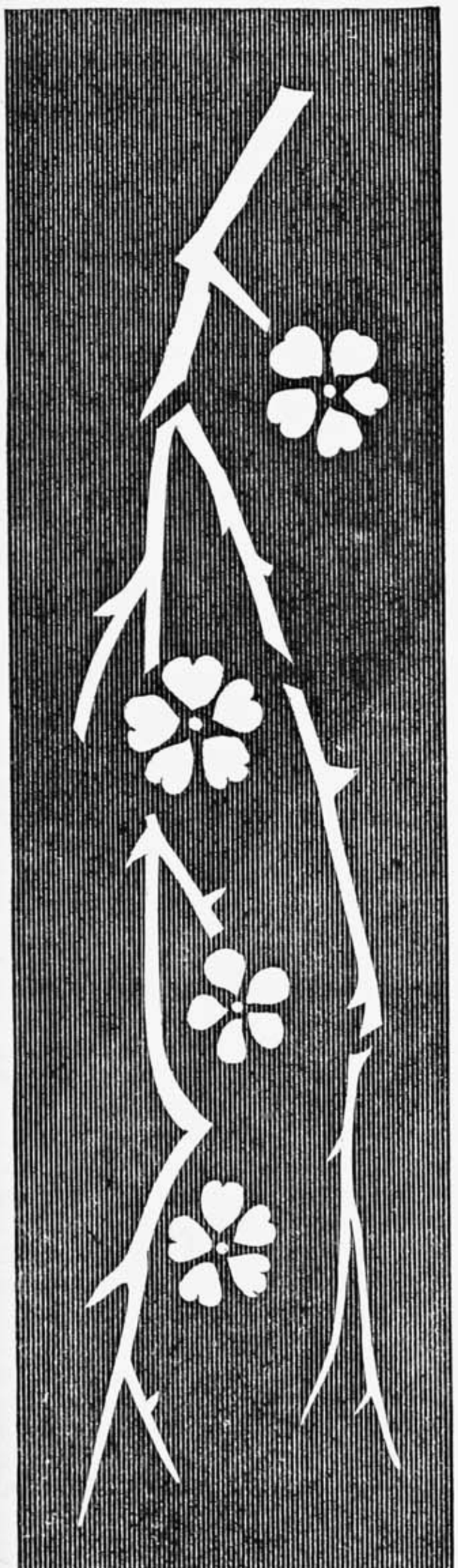

Fig. 4.—Cover of Pen Box, hinged to the Division Piece—Cut One.

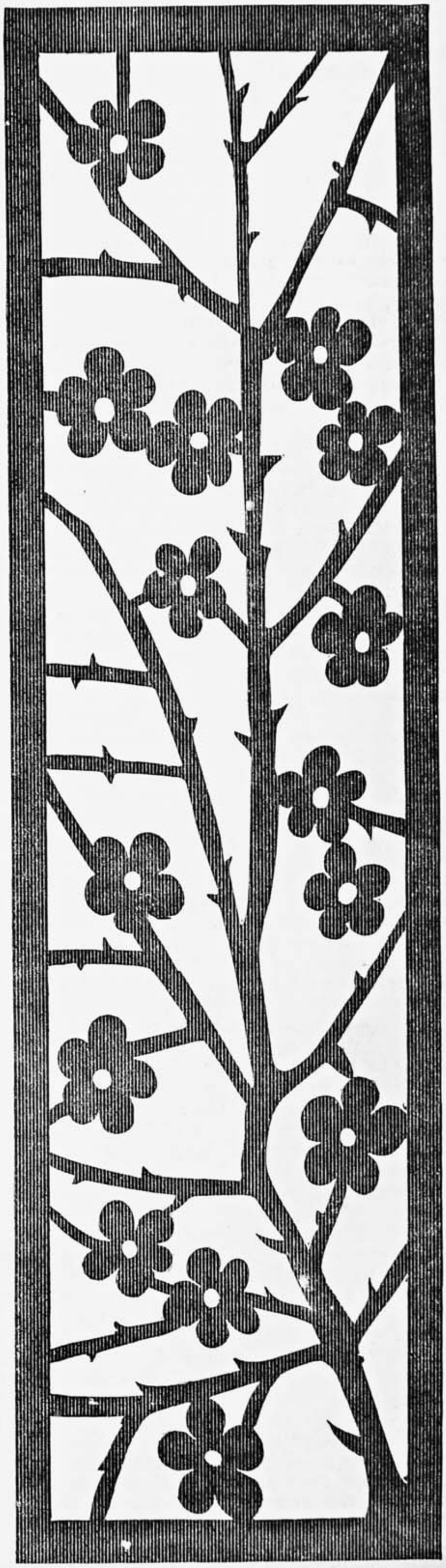

Fig. 5.—End of Tray, opposite to Inkstand, etc.—Cut One.

VENEERING.

A CONSIDERATION OF THE OBJECTIONS URGED AGAINST IT AS A SHAM.

BY DAVID ADAMSON.

PROBABLY no operation or mechanical detail connected with cabinet making has been more unfavourably commented on, even when it has not been utterly condemned, than that known as veneering. This, as almost every one is aware, consists in covering a piece of wood with a thin layer of some choicer wood, the latter being the veneer. Perhaps before explaining how to veneer it may be well, in order to remove prejudices, to glance at some of the objections most commonly urged against veneered surfaces, and see whether they are valid or not. Personally, as one who has given considerable attention to the subject, I can unhesitatingly say that I see no objection to it when properly done, and in this I imagine I shall have the support of all practical cabinet makers.

One reason which is sometimes brought forward against the process is that veneering is a sham, and therefore degrading in its tendency both to the workers and to the public, the users. No more mischievous assertion than this could be made, and it is one which it is difficult to think could ever be seriously urged. Were veneering generally practised with the intention of deceiving there might—nay, indeed would—be strong grounds for condemning it, but can any one with the slightest practical acquaintance think for a moment that veneer is put on with the intention of implying that the substance is the same throughout its entire thickness? I only now refer to those who have some knowledge of both material and construction, for it may be conceded that others occupy a somewhat different position, and their views may for the present be disregarded. To the cabinet maker therefore, whether professional or amateur, who may not have any definite ideas on the subject, a few suggestions are offered for consideration. They may help the former class of worker especially in enabling him to refute any assertions which may be made by customers and others against veneering. Perhaps in this latter sentence I may seem to the fastidious amateur to be talking too "shoppily," but while there is no wish to tread on his toes, I may say that I am only too familiar with the frequently absurd notions of the public—that is those whom I have classed as "customers"—not to be desirous of giving sound argument, or rather by suggesting how some of these notions may be combated. In the pages of WORK we meet on neutral ground, where those who know what they are talking about in practical matters can state their views without any fear of being misunderstood as to their motives. For example, were a cabinet maker in the ordinary course of his trade to inform a customer prejudiced against veneer—I use the word prejudiced advisedly—that his or her objections were unfounded, that customer would probably, or let me say possibly, go elsewhere. The cabinet maker may make a mild explanation about the propriety of veneers, and with a reasonable person may succeed in carrying conviction, but the chances are his explanation, in the great majority of cases, would be put down to personal interest. This can hardly sway any one writing for WORK, so, however wide my views about veneering may be from those of some readers, please remember that did I think the process immoral I should have no more hesitation in condemning it than I have in upholding it.

As has been stated, no cabinet maker could long be deceived, even were he momentarily so, by veneered wood. As a rule a very slight inspection, a cursory glance, shows him what the construction is; therefore, so far as he is concerned, there is no deception. To him veneering simply offers a ready way of decorating a plain wood, and to employ a well worn simile it is no more deceptive than the gilding on a picture frame. No one would, because this looks like gold, ever imagine that either the maker or owner intended to imply that it was formed throughout of the precious metal. But, it may be urged, gold and wood are not analogous materials, that no comparison can be drawn between them—the one being of such extreme value, and the other common enough. This is correct to a certain extent, and only so, for though gold and wood are not of the same value, it is only the choicer kinds of the latter which are generally used for veneers, either because they are too costly to be worked up solid, or, as is the case with some of them, because they cannot be used in the solid form. On examination we find that similar processes are practised in almost every branch of manufacture and art. If we are to be logically correct according to those who object to veneering, we cannot stop short at this form of decoration. We must not only denounce it, but every other method of surface or superficial adornment, for they are all to the same extent debasing and false. We might varnish our front doors, for instance, just as a preservative, but paint them, oh dear, no, because that would be done with the intention of persuading passers-by—perhaps in time deceiving ourselves—that the humble pine of which they are made is a nice olive green throughout. Does, for instance, the æsthetic individual who paints his woodwork ivory colour do so with a thought that possibly some one may be deluded into believing that it is actually of ivory? If that is his intention, he certainly is not less blameworthy than the cabinet maker who is so unhesitatingly found fault with for decorating his plain wood. In the one case a thin coating of paint is used; in the other a thin coating of wood. Where the difference in principle lies I for one cannot conceive, the distinguishing feature between them being that one is laid on in a liquid, the other in a solid form. Of course the æsthetic individual, be he professor or other man of light and leading, would indignantly repudiate any intention to deceive, but none the less he is quite ready to impute all sorts of bad intentions to the wicked tradesman who dares to adorn a piece of, let us say, American walnut with a piece of choice "burr." Oh, the ignorance of such would-be teachers, who have unfortunately, however, got the public ear by virtue of their position, for admiring this self-same wood or variety of wood, burr walnut; they would say, "It ought to be solid, else is it a sham, and we will have none of it." How many of them are aware that it, and many other woods, amboyna, thuja, and others, *cannot* be used in the solid form. They are merely superficial decorations, the same as the aforesaid ivory paint, and could not by any possibility be used structurally more than it.

If veneering with wood is wrong in principle, then also is coating a surface with paint or other adhesive covering for the purpose of rendering it more pleasing to the eye. To allege this latter is, of course, ridiculous, but it may well be asked, is it any more so than to say that veneering is wrong? It is difficult to know where to draw the line between the false and the true in art, and no attempt is made to do so in these remarks, which are merely made to explain what one can only suppose are erroneous conclusions, founded on an inaccurate and imperfect knowledge of the process and intention of wood veneering.

Even Ruskin, if I remember rightly, does not object to thin sheets or veneers of marble being used for the adornment of buildings in Venice, and surely what is permissible in them there, can hardly be wrong in furniture in this or any other country. The materials are different, but the principle is the same. If it is not proper to cover a base wood with a more valuable one, it can hardly be right to cover a common stone with a choice marble. But this brings us very near to the adornment of brick buildings with an outer coating of more or less ornamental stucco; and it may be asked if this also is to be considered as a veneer, and to be advocated for the same reasons. Such a question is a very natural one, and is not lightly to be dismissed, though to discuss it at length would lead far from the present subject. It will be sufficient to suggest that properly applied veneers on furniture, and stucco on buildings, are scarcely the same in character any more than in material. The object of both is the same, viz., to render a surface more pleasing to the eye by external finish than it would, to the majority of people, be without it. Here, so far as our present purpose is concerned, the resemblance ends.

Undoubtedly, one great reason why veneering is regarded with disfavour is on account of the faulty manner in which it is sometimes used, and the facility with which it may, by unscrupulous people, be taken advantage of to hide defects in work or material. I am far from saying that all veneer is correct, either in application or intention, for unfortunately this cannot be affirmed with accuracy. It must be admitted that sometimes one finds veneers used in a manner which cannot be justified, but at the same time the whole blame must not be attributed to the workman or the manufacturer, for if certain classes of the public did not demand articles at impossible prices, the production of low class furniture would, to a very great extent, cease.

When veneer is used on an unsuitable wood, or otherwise improperly, it is, of course, not to be commended, but might not the same be said of any other operation? It is not the veneering itself which is wrong, but the mode of work which is at fault. Even when furniture is made without veneer, it is quite possible for it to be defective; but no one on that account would say that it is wrong to make it solid, *i.e.*, without finishing it with veneer. The remedy lies in seeing that all the work is properly executed, not in abandoning a process. Taking a further and usual mode of finishing furniture, French polishing, it might with equal justice be urged, that because this is occasionally badly done, therefore no polishing is to be regarded with anything but feelings of reprehension. It will be observed that nothing is said about personal likes or dislikes of brightly polished surfaces, as that does not affect the comparison. I only want to show the unreasonableness of utterly discarding a process which is

commendable, or, at any rate, allowable and useful, simply because it is sometimes abused.

OUR GUIDE TO GOOD THINGS.

73.—The Smallest Thing out in Planes.

A correspondent has called my attention to what may be called the smallest thing out in planes, and has sent me a specimen for testing. The body of the plane, which is of iron apparently nickel-plated, is barely $\frac{7}{8}$ in. long, a little over $\frac{1}{4}$ in. wide, and a little less than $\frac{1}{4}$ in. deep. The interior is cut away from the top, so that the hollow thus formed has a V shape, the sides being inclined to one another at a right angle. There is a slot at the bottom to allow of the projection of the edge of a tiny cutter, about $\frac{3}{16}$ in. in width, which is attached to one of the sloping sides of the interior by a small screw. At one end is a split ring, by which the plane may be worn on the watch chain. The cutter is made of the best steel, and being sharp and capable of being sharpened at pleasure, the plane, small as it is, may be used to take off the fine edges in delicate cabinet work, or to sharpen pencils. I am told the price of the plane is 1s., and that they can be purchased of Mr. E. Walker, 20, Legge Street, Birmingham, of whom any further information respecting them can be obtained.

74.—The "Firm and Safe" Step Ladder.

The step ladder shown in Fig. 1 of the accompanying illustrations shows the best form of this useful household appliance that has yet been introduced. The old make of step ladder, for use chiefly in the dwelling-house, was similar, it is true, in general appearance to the "Firm and Safe" Step Ladder, but it will be remembered that the only means whereby the back was kept from spreading out to too great an extent from the front was by a couple of pieces of cord, which permitted the extension of the steps just so far as their length would permit, and no farther; and sometimes if the cords were not fully extended, the ladder might sometimes slip under the weight of the person who was going up the steps, and a serious fall result from the slipping. This step ladder, however, is fitted with Gibson & Glazier's Patent Locking Stay in lieu of cords, and it is in this fitting that its firmness and safety are found; rendering it the means of supplying to perfection a long-felt want, namely, a thoroughly well-made and absolutely safe article, both for domestic and trade purposes: for the Patent Locking Stay gives strength and stability where it is absolutely required, thus rendering the step ladder under notice the best and most reliable article in the market.

The form and nature of the Patent Locking Stay is shown in Fig. 2, in which it is represented when the ladder is being closed. It consists of two parts, a straight bar, one end of which works in a socket, screwed to the bottom of one of the steps in the front of the ladder, to which it is secured by a pin riveted without the socket at each end. The other end also works on a pin passing through the straight bar, which is placed between two curved bars, which work on sockets screwed to a rail across the back of the ladder. When the ladder is closed, the straight bar is erect, and drops into a notch cut for it in the step to which it is attached. The curved bars are also erect, or very nearly so, and are in the framing of the back above the rail to which they are attached. When the ladder is opened, the bars gradually descend until they come into one and the same plane, forming a rigid extension between the front and back of the ladder. When in this position they are locked and prevented from moving by a brass bolt or button shown at A, which is clamped to the straight bar and travels along it. When this is withdrawn, the locking stay can be lifted, and the step ladder closed.

In addition to being secured in this manner, the step ladder itself is also well and stoutly made of good, sound inch timber. The steps are grooved into the sides and securely nailed, and under the bottom step and second step from the top, a turned wooden pin, $\frac{3}{4}$ in. in thickness, is placed, which, it is claimed by the manufacturer, makes a much sounder and stiffer job than iron pins, or even tenons, on the ends of one or two steps. The top rail of the framing which forms the back is purposely kept below the uppermost step but one, so that when the step ladder is open it will not be in the way of the feet of any one when standing on that step. Moreover, this arrangement permits pulling through a scaffold board on that step, which is frequently required by painters, decorators, whitewashers, etc., for whom a couple of sets of step ladders will serve as admirable trestles for forming impromptu scaffolding. For the use of tradesmen, such as those just mentioned, larger ladders are made, somewhat heavier, and it is absolutely impossible, on account of the rigidity afforded by the stay, for the back legs to wriggle or twist about, as is the case with steps that are fitted with cords. The ladders have a nice appearance, being stained and varnished before being sent out. I can speak favourably of them, having had one in use in my own house for some few weeks in order to test it thoroughly, and the result is that the old steps with cords have been turned out to make room for the new comer. I should say that the "Firm and Safe" Step Ladder is manufactured and supplied by Mr. William Glazier, 97, Tulketh Street, Southport, Lancashire. The price of each ladder depends on the number of steps of which it consists, the price per step being 1s. 3d. The locking stays are supplied for fitting to any make of ladder, in three sizes, sold respectively at 18s., 21s., and 24s. per dozen. I strongly recommend carpenters and joiners who are in the habit of making these appliances for sale, to provide themselves with a supply of Gibson & Glazier's Patent Locking Stays, and to send out no step ladder without it: and upholsterers will be wise to add the "Firm and Safe" Step Ladder to their stock, and exhibit its decided advantage over the old steps with cords to all customers who may be in search of such an appliance for home use.

Fig. 1.—Step Ladder Opened and Locked for Use.

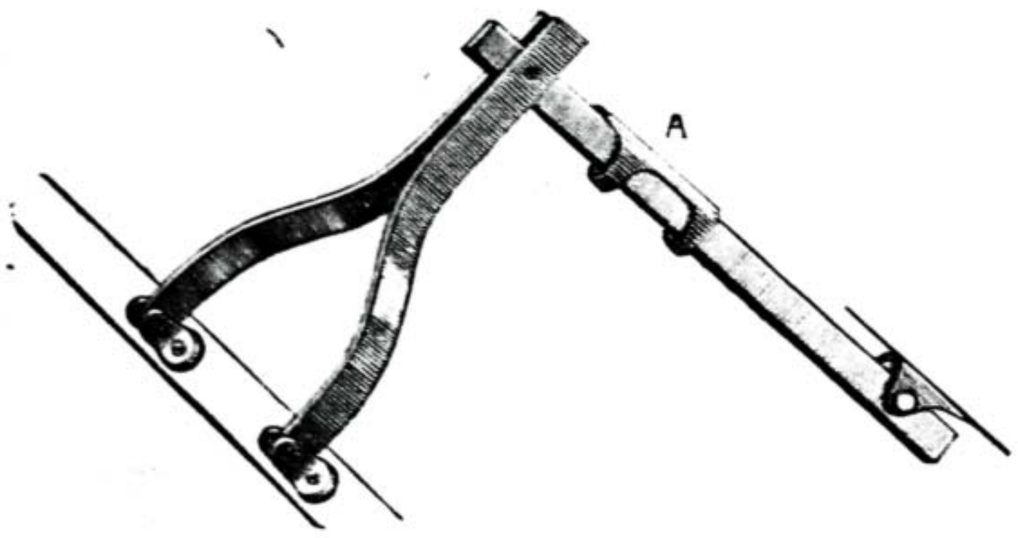

Fig. 2.—Position of Stay when Ladder is being closed.

75.—Vevers' Registered Plate Lifter.

Mr. C. C. Vevers, 12, Market Street, Briggate, Leeds, sends a new edition of his "Practical Amateur Photography," which is sold at 6d. This handy little book is divided into two parts, in the first of which the different processes in the art of taking a photograph, from the operation of taking the negative to the finishing of the point, are described in clear and simple language, calculated to make each step intelligible to the amateur beginner. One formula only is given for each operation, which is beneficial in enabling the learner to avoid the uncertainty, both of mind and action, which invariably sets in when a number of recipes are given at the same time, without any indication of the best for the beginner to take in hand and test under particular circumstances.

The second part of this *brochure* is more advanced, and therefore better suited to those who have mastered the rudiments of the process, and are ready to proceed beyond the beaten path described in detail in Part I. Thus the second part contains directions for working the Celluloid and Eastman films, for carrying out the carbon, platinotype, gelatino-bromide, and other printing processes, with formulæ for various developers and toning formulæ.

The "Registered Plate Lifter," sent by Mr. Vevers, looks very much like a thimble without a top, with a piece of metal extending from one side of the finger-socket for about 2 in., in the form of an elongated finger nail. The plate lifter is placed on the top joint of one of the fingers, and the plate is lifted from the bath by means of the metal projection already referred to. Of its utility or advantages I am unable to speak, but Mr. Vevers states that an enormous number have been sold since the time that he first introduced them, which was only a few months ago. Some, however, consider that its use would be detrimental, inasmuch as the plate might be scratched by the point of the metal. Be this as it may, it would certainly keep the tips of the fingers clean if it did nothing more. It is right to add that at the end of the book a set of chemical labels, printed in bold type on paper gummed at the back, will be found. The photographer will find these extremely useful, as they can be detached when required by the aid of a penknife or scissors, and attached to the bottles containing corresponding chemicals or solutions, relieving the owner from the trouble of preparing written labels for the purpose of distinguishing the contents of the bottles on which they are placed. Among other new matter will be found notes and remarks on the new platinum process and the hydroquinone development. A frontispiece is also added, which affords a good example of flash-light photography, reproduced in photographic zinc etching.

The Editor.

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SHOP:

A Corner for Those who Want to Talk It.

*** Notice to Correspondents.—*In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of* Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

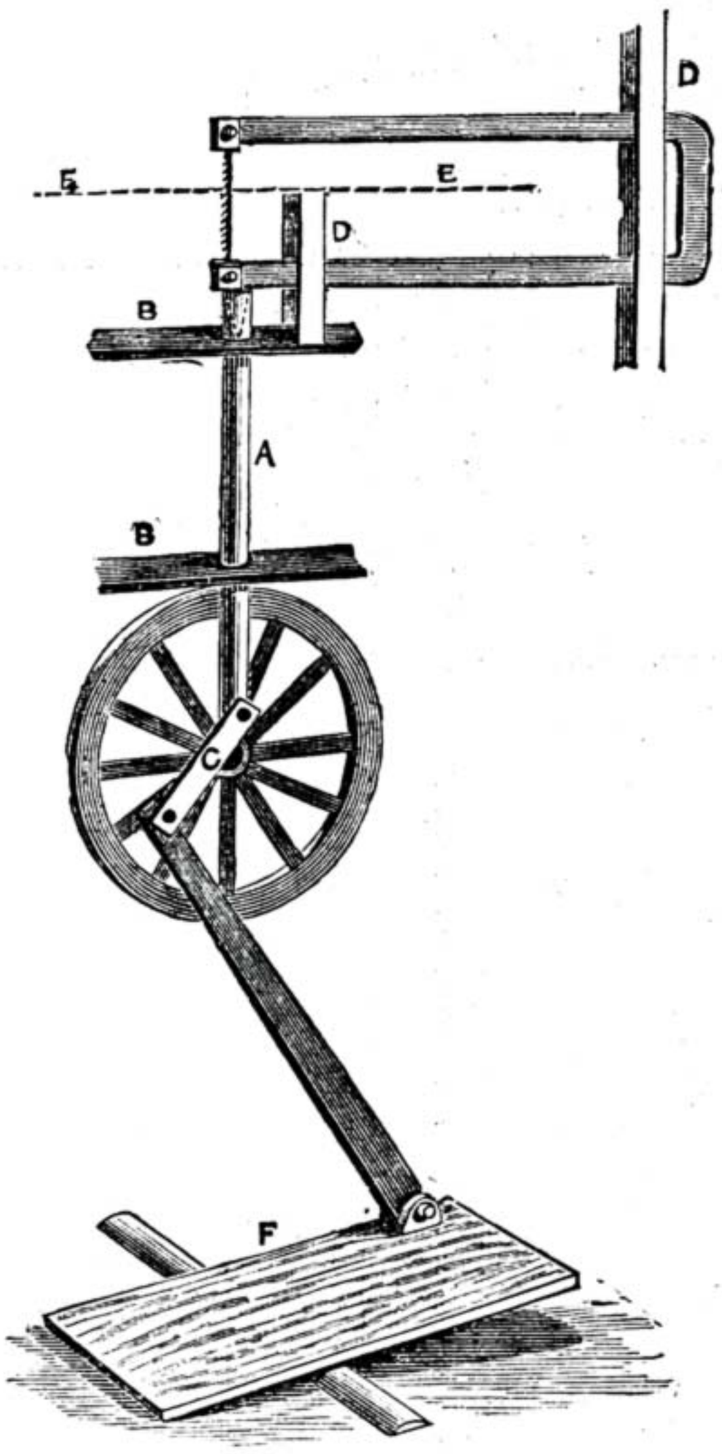
I.—Letters from Correspondents.

Pit Frame Saws and Paste.—G. W. (*Bournemouth*) writes:—"Is same inserted in No. 15 simply to fill space, or to give some superannuated wheeler a lift? His construction may do for a coster's wheel or perambulator. How about wheels, say, from 2 to 6 in. tyre? Had he taken the trouble to look in any good London wheelwright's shop he would see the *pit* is a necessity, and not confined to the country. If it is meant for amateurs it is merely waste of valuable space. If for pro.'s they will simply 'smole their smile,' as not one in 500 will undertake such laborious ill-paid work as wheeling. Should they feel like it, let them apply your tip. French prepared wood may now be bought (at less cost than English stuff in the rough) ready to put together. The cost of putting together machine stuff is for labour only from 6s. to 16s. per pair; barrow wheels, 1s. each. You will see it is about as useful as teaching how to make a hatchet. How does the set stick work? Is mortise cut long? The way of securing the nave weakens the frame, causing it to spring at every blow. Could send you simple, cheap, secure fastening (sketch of). J. H. seems to know something of saws. Some amateurs may not be able to procure a set. To them I would say push on with what you have. I made three carriage bodies with nothing but a piece of hand saw. If a sharpener is not handy, do it yourself. If for hard wood sharp, with square points, or not quite so pointed as J. H. recommends—that is, where only one saw may be at hand. J. R. will be answered, no doubt, in your papers on coach building. I much doubt whether paste will answer for office work, being too long drying."

Advertising and Advertising.—Handel St. Clair writes:—"Your note to hand regarding advertising plans for cottage. You misunderstand me. I only sent the design for the benefit of your readers, and to let them know that they can obtain full drawings of same for small sum, as all are invited to do in *Illustrated Carpenter and Builder*. As to its being an advertisement, what are all these lathes, etc., that you exhibit and recommend for the Britannia and other companies, but advertisements? Be that as it might, I do think you should try to introduce plans for houses. You might do worse than follow one of your correspondents' advice—to give prizes for best designs. I am certain it would prove an interesting study for everybody, and be something practically useful instead of filling your periodical with fretting, carving, embossing, repoussing, and such like rubbish, fit for none but professional amateurs who have more time than talent, and more money than sense."—[When you asked me to publish designs for cottages, and acquaint readers that they can obtain full drawings of same for small sums, you simply asked me to advertise your designs in Work, and I wrote, telling you to apply to the advertisement department, who would give you terms, etc. The notices that I give in "Our Guide to Good Things" are not advertisements. Makers and dealers invite notice of their goods in precisely the same way that publishers invite notice of the books they publish in newspapers and literary journals. Everything is reviewed on its merits, and whenever you like to send me any article you have invented or made for general sale, I shall be happy to do the same for you as I do for others.—Ed.]

Scribing Wheel.—J. W. (*Burton-on-Trent*) writes:—"I beg to ask your opinion of what I think would be an advantage or improvement in compasses. Sometimes in scribing skirting down to a floor with the ordinary compass, the leg marking the wood is apt to follow the grain, unless great care is used, thereby causing wood to be cut away where it is not wanted. What I would suggest is that one leg should have a small revolving wheel, instead of the ordinary point, the wheel to be ground to a fine edge, and toothed. I think it would then run over the surface of the wood without following the grain, and it would answer quite as well as the ordinary compasses for describing circles, or any other purposes to which they are put. If you will kindly reply in 'Shop' and tell me what you think of my suggestion I shall feel greatly obliged. You need not put it so that any readers of Work would understand it, as I should like to have the advantage of it if there is any."—[I give your letter in full. I need only add that your idea is correct in theory, and will be found so in practice. It is the principle of Barrett's improved combination roller gauge described in No. 13, page 203, to which I may refer you. In this the ends of the bars are fitted with revolving wheels, which will leave a mark even on the hardest knot.—Ed.]

An Easily-Made Fret Machine.—W. R. S. writes:—"The fret machine here illustrated claims to possess the following recommendations to the amateur:—A vertical stroke, easily constructed, and can be made for a few shillings. The parts required are as follows:—A wheel 12 in. in diameter; two pieces of bar iron ½ in. × 1 in., the frame of an ordinary iron hand fret saw (one with a spring in the back will be found best), costing 1s.; and 2 ft. of ½-in. brass gas-pipe. First fix the wheel about 18 in. from the ground; above this place the two pieces of bar iron, B, bored with a half-inch hole in the



An Easily-made Fret Machine.

A, Piece of Brass Gas-pipe. B, B, Pieces of Bar Iron, with half-inch hole bored in the centre of each, to take the Shaft, A. C, Treadle Crank. D, Slide for the Frame to run in. E, Table. F, Treadle.

centre, placed a foot apart in these holes; insert the piece of gas-pipe, A, having previously bored a hole, and flattened the end nearest to the wheel. Great care should be taken to see that the pipe comes exactly over the centre, as the successful working of the machine will depend upon this. Drive a piece of beech, or any similar hard wood, in the other end, and in this strongly fix the iron frame. The far end of the frame and the part under the table should have two slides, D, made of mahogany; this will steady the frame when running. The treadle can be made in the ordinary way; of course the throw of the machine will be double the distance from centre to centre of the piece marked C. I have tried to make the description as lucid as I possibly can; but should any difficulty be experienced by the reader, I shall be happy to answer queries through the columns of 'Shop.'"

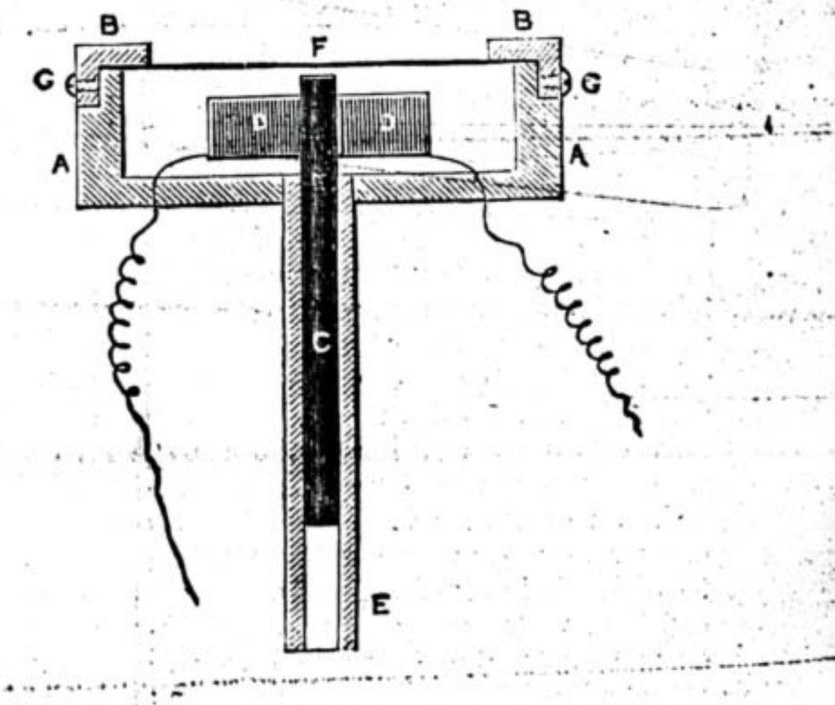
Elizabethan Twist in Lathe.—W. P. W. (*Newport, Mon.*) writes in reply to C. C. E. (see page 109):—"C. C. E. still believes there is no lathe in existence in which the spiral can be cut and finished by the tool. He says it might be fairly done by a complicated apparatus in ivory or hard wood. But he will be surprised to know it can be done in any wood. I have a piece cut in yellow pine 1¼ in. pitch, with only the cutter, and I believe sand-papered afterwards. There is no costly or complicated apparatus required for this work; any lathe having an overhead gear, and any means (whether screw cutting or not) to determine the pitch, is equal to this task. My own lathe is a 4½ in. centre screw cutting with overhead gear. With this I have no difficulty in making a 'convex curve die into a concave without a break,' as easily as shelling peas. If C. C. E. was referring to me when he said 'he had found such men as you referred to, but could never run them to ground,' he will have no such difficulty with me. You are welcome to give him my address, and I am willing to show him my tools, or, as I promised before, he can have a specimen cut."

Back Numbers.—X. M. T. C. C. (*Belfast*) writes:—"Having had the good luck to fall in with No. 14 of your very valuable little paper, I am determined to take it constantly, as I find a great deal of good information in it. But I am sorry to say that I missed the first number of it, so that is what is making me write this miserable letter to you. I want you to let me know, through the medium of 'Shop,' if you could supply me with Work, from Nos. 1 up to 13, as I have got 14 and 15. If you have them, please let me know the cost of sending them to Belfast, and I will send name and address. Hoping that you may have all the numbers of Work that I want, I wish you every success with your undertaking."—[Nos. 1 to 13 of Work can be had by order of any newsagent, or the publishers can send the thirteen numbers free by post, on receipt of your remittance for 1s. 3d.—Ed.]

About Work.—A Well-wisher (*Dover*) writes:—"Being an amateur workman, I have often wished for a book that would be useful, but have always found them beyond my means, with the exception of one or two works with which I had to content myself until I first saw your valuable publication, Work. I should like to thank you for your endeavours to meet the requirements of such as me. I cannot tell you how valuable Work has been, is, and I trust will be, to me; nor how I long for Wednesday to come round that I may get the next edition. I have not yet made the overmantel nor the bureau, but I am making a cornice similar to the one given in Work. 'Shop' is a proper corner of tit-bits for every one."

Enlargement of Work.—Kildonan (*Inverness*) writes:—"Permit me briefly to enter my dissent from the suggestions of F. A. C. (*Bradford*), and others, as to the enlargement of Work, and its consequent increase in price. Personally I should be quite willing to pay 3d. weekly for a larger paper, and would not feel it a very heavy tax on my resources; but what about the hundreds, it may be thousands, of young workmen, apprentices, and poor working men with large families and small wages to whom the present cheap and good publication is a great boon, if the price were raised? It may be a paltry sum for well-to-do tradesmen, and others in comfortable circumstances, the extra 4s. 4d., or 8s. 8d. annually, but it is not so to many an artisan, and I think it would be opposed to the traditions of the great house of Cassell & Co. to place their publications beyond the reach of the working classes. I am speaking, of course, of the poorer sections. I have no doubt the publishers know their business quite well enough without outsiders like myself poking our noses in and offering suggestions as to what should or should not be done; but it occurs to me (and I offer the suggestion in all humility) that when the volume is bound the advertisements on the last leaf of each number will not be pleasing to book lovers generally. If a coloured (or any) wrapper were issued with each number, would not the advertisements pay the outlay arising therefrom? This would throw open two more pages of Work for the editorial staff (N.B.—No *goak* meditated here), while the cover would be valuable in keeping the numbers clean while being read or used from week to week. I do not by any means wish it to be understood that I would not like to see Work enlarged; but I hold that it is an excellent pennyworth as it is, and knowing from past experience the scarcity of pennies with many lads learning their trade, I think it would be a pity to raise the price. I have not noticed any one taking this side of the question, and seeing so many advocating the extension in size and price, I have taken the liberty of glancing at the other side."

Telephones.—J. W. C. (*Clapham Common*) writes:—"I am taking in your paper, which I think very well written, and not like many books of the same class, which are full of suggestions which are anything but practical. I have spoken to several practical men, who think it a very useful paper, and intend taking it in. I wish to ask you a



few questions on telephones. I see in Work for June a note in 'Shop' in reference to this subject, from which I am led to infer that it will be put off for an indefinite period. I wish to make telephones that would not cost more than 5s. not including the batteries, and that would be strong enough to work a distance of about 50 ft. of wire between the two telephones. The sketches on

slip enclosed will show my idea of what might be done. A A, B B, might be a tooth-powder box and cover; what size? C, bore of iron wires to coil; what diameter? D D, coil; what kind and quantity of wire? E, a wooden cylinder with hole drilled through centre to admit end of core, and to fix it, and then glued into a hole at bottom of A A. F a vibrating plate of some description; what made of? same size as edge of box to snap on with cover; or if that is not firm enough, a small screw to hold it on the cover as at G. The circular hole in cover to extend nearly to inside edges of A A. What batteries would be required of Leclanché's pattern? This is something similar to a sketch I saw eight or nine years ago."

II.—Questions Answered by Editor and Staff.

Mechanical Drawing.—R. R. W. (*Glasgow*).—If you are unacquainted with drawing, you cannot do better than join the local school of art in connection with the Science and Art Department, South Kensington. You will at least get the rudiments then; but if you wish to teach yourself you can hardly have more reliable guides than Cassell's Popular and Technical Educators. You must not, however, think that you can get much practical knowledge without experience under a competent draughtsman in the special line you wish to study. By all means try and get into an office as soon as you have acquired a slight knowledge of what is required and have a general idea of what to do. Your scholastic and practical training might very well be pursued together.—D. A.

Hammering Saws.—Tancred.—You wish for a practical paper on striking a buckle out of a hand saw, and say that there is hardly one joiner out of a hundred that can do it. I quite agree with you in this. The difficulty is in determining precisely where each successive blow should be delivered, so as to take out the buckle and bring all the atoms of iron that form the blade into one and the same plane, relatively speaking. Each blow tends to alter the position of certain particles, and to drive them one way or the other, and the percussion must be continued until a proper distribution of the atoms is once more brought about. I doubt the possibility of dealing with such a subject otherwise than theoretically, for I feel sure that every buckled saw blade would require different hammering, so to speak, and it is only an expert who has been long accustomed to the work who would at once recognise where to strike and how hard a blow to deliver. By my reply I have given publicity to your inquiry, and if any reader can, and will, give us a paper on the subject, I shall be glad to receive it, and produce it in Work at the earliest possible date.

Clay for Making Earthenware.—Potter.—Devonshire and Dorsetshire furnish most of our clays for this art; much depends on the mixing and preparing; and it will probably be best to buy clay ready prepared from a pottery. At such an establishment as Messrs. Doulton's, Lambeth, we imagine that almost any variety desired would be procurable. The exact speed of the potter's wheel we cannot tell; the rate is not uniform, but constantly varied according to the requirements of the "thrower" (the workman who shapes the vessel), and in obedience to his directions.—S. W.

Protecting Papier-Mâché Boat from Sea Water.—Bofin (*Galway*) may protect his papier-mâché boat from the action of salt or other water by painting it with a solution of gutta percha or indiarubber. As he may find a difficulty in buying such a solution at the shops to which he has access, he may make one by dissolving gutta percha in naphtha and adding a little shellac; the consistency should be that of thinnish paint.—S. W.

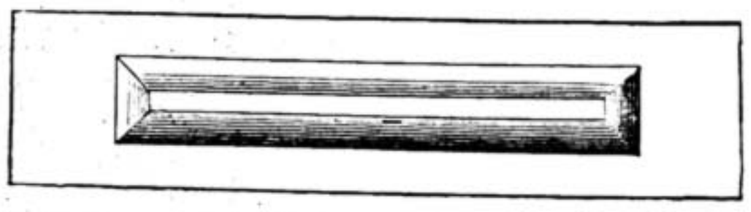
Electric Gas Lighter.—H. (*Brighton*).—You evidently refer to Clarke's patent gas lighter. I cannot give you detailed instructions, or how to make one of these instruments. I do not consider the price at all prohibitive. There is much fine and exact work in one of these little instruments. They are really miniature cylinder machines for producing static electricity.—G. E. B.

Electric Belt.—Tinman (*Homerton*).—"A medical galvanic belt" may be made by linking 1-in. discs of lozenge-shaped pieces of zinc and copper to each other alternately. Two of such chains should be sewn in a flannel belt with a piece of flannel between the chains; the alternate links of each should form galvanic pairs. When the flannel is moistened with vinegar or with sweat, a current of electricity will pass on joining the ends together. But what good purpose will this serve? Will such belts cure or alleviate pain or disease? I have never known them to do so.—G. E. B.

Wood for Engraving.—Tom.—The wood on which woodcuts are engraved is boxwood—a yellow wood, hard and close in texture. Letters for printing may be cut in apple or pear wood. I cannot tell you where evening classes are held, if held at all, at which the art of wood engraving may be learnt. Were it not good for trade, I should be sorry to hear you have already lost Nos. 2, 3, 5, and 7 of Work. All numbers are kept in stock, and can be obtained at any time through a bookseller or newsagent who also supplies serial publications.

Arts and Crafts Exhibition.—E. S. (*Salisbury*).—For regulations for exhibitors and form of application for entry, apply to the secretary, Mr. Ernest Radford, 45, Great Marlborough Street, London, W. I shall be happy to give publicity to all forthcoming industrial and other exhibitions, in order to bring them under the notice of workmen, professional and amateur, who may be readers of Work.

Cutting Bevelled Recessed Mounts.—W. A. R. (*Hanley*).—A professional mount cutter when cutting cushion, oval, dome, or any fancy shapes, depends upon his eye and steady hand, after marking out in pencil size and shape requisite. In cutting straight bevel or square openings for water colours, photographs, etc., I use a cardboard bevel edge as a guide for regularity of bevel, which is made by cutting a slit in a long piece of card, thus:—



Tools for mount cutting:—Steel straightedge, for marking straight lines; knife blade and handle; one pair dividing compasses; black lead pencil; eraser (piece of indiarubber); lining pen for making gold lines; 3-ft. rule; cotton and pins for marking ovals; oilstone; one set square; one bevel slot; which are not usually sold, as there is a certain amount of jealousy against the amateur. There is no book published, that I am aware, of practical utility to frame makers, etc. The City Frame Company is willing to supply any article for frame making, mount cutting, etc., and show amateurs their works.—G. R.

Papier-Mâché.—Fairflax (*Dartmouth*).—We see no reason why ordinary brown paper should not do for pasting panels, if porous; though so far as we are aware nothing so stout has been used in the trade. The glue is put into the paste by guess; it is hard to name an exact quantity, but for such stout paper ¼ oz. to the half pint would probably not be too much. At any large tool shop, a curved rasp may be got; or an ordinary rasp, which any blacksmith can bend to shape, will answer the same purpose. Black japan (black tar polishing varnish) may be got at Thornley's, 8, Snow Hill, Birmingham, at about 3s. 6d. per gallon; but Fairflax can doubtless obtain current price by writing to that address.—S. W.

Wood for Suite.—J. A. (*Castleford*).—A good deal depends on the kind of suite you want to make, but from your reference to table I presume you mean one for a bedroom. If so, red pine free from knots would do for cheap work, but ash is more suitable, and is frequently used for light bedroom furniture. Birch is another favourite wood for the purpose, though not so much used as formerly. Speaking generally, any of the lighter-coloured woods are suitable for your purpose.—D. A.

Picture Moulding Sellers.—L. S. B. (*Stepney*).—I should think if you apply to City Frame Company, 29, Basinghall Street; they supply every requisite for frame making and mount cutting at most reasonable prices, and undertake to supply at a special discount subscribers to Work. As an example, they would supply your glass in 300 ft. cases, picture quality, at 1½d. per foot, ¾ best washable gold moulding, from 5d. per 9 ft. length, or 4s. 6d. per dozen, etc. etc. If you write or call, they will supply you a set of samples and prices of anything you may require.—G. R.

Regilding Looking Glass.—B. N. (*West Ham*).—Firstly, take your frame without the mirror, and thoroughly dust it; take a bowl of warm water, and wash the old size off, leaving gold but clean. Apply a thin coat of japanners' gold size with a soft brush, and then put the gold leaf on with a gilder's tip, and wipe off with cotton wool, so as to make it smooth when dry, then apply a coat of clear vellum size, which adds softness to the gold, and keeps it much longer.—G. R.

Patents.—W. H. W. (*Liversedge*).—(1) The £1 you refer to is the Government stamp for a provisional protection, which is generally a preliminary to applying for a patent. The provisional protection extends for nine months, but has not the entire advantages of a patent. (2) You can apply for your complete patent any time within nine months from the date of the application for your provisional protection. (3) The Government stamps in all for both these matters are £4. The address of the Patent Office is 25, Southampton Buildings, London, W.C.—G. H. R.

Brickmakers' Clay for Modelling.—W. G. C. (*Sudbury*).—The clays used for brickmaking vary widely; that of which fire bricks are made is very good for the purpose; but most ordinary brick clays are impure, and not sufficiently plastic to work well. Still, if W. G. C. cannot readily get Devonshire pipe clay, or any other comparatively pure clay, he may make shift with the clay nearest to hand by thoroughly well tempering and beating it up, and sifting in some fine sand to render it more plastic. As regards instructions, he will soon see all he wants in Work. Comprehensive articles on modelling, by a professed figure modeller, are already written, and will appear shortly.—S. W.

Electric Lighting.—T. P. (*Hull*).—This subject will be taken up and thoroughly dealt with in time. As I have had occasion to say before, it is beyond possibility to handle every subject at once.

Right and Left of Drawings.—R. H. H.—On the stage, right and left is according to the position of the actor as he faces the audience. R, signifies to the actor's right hand; C, the centre of the stage; and L, to his left hand. In drawings, however, the convenience of the person who is looking at them is consulted, and that part or side of a drawing which is opposite to his right hand is spoken of as its right, and that opposite to his left hand as its left. I trust this will make the directions already given perfectly clear.

Beaton's Pocket Technical Guide.—P. J. (*Doncaster*).—The price of this handy waistcoat pocket volume, published by Messrs. Crosby Lockwood & Co., Stationers' Hall Court, London, E.C., is 1s. 6d.

Alleged Mistake.—B. S. T.—Your letter having neither name nor address might be disregarded as anonymous, which, when an assertion such as yours is made, should not be. However, *pour encourager les autres*, I give it attention. Of course, if the article you comment on were made according to the diagram you send, the result would be as you say; but it is nowhere stated by the writer that both pieces are to be of the same length. The hinder one must naturally be shortened at the free end sufficient to give clearance, and in writing the description it was taken for granted that readers would understand this, especially as the illustration, Fig. 1, shows that one support projects further than the other. The drawing being in perspective, you have probably overlooked this. If you object to this formation, you can easily adapt supports which are of equal length, by hingeing in the same line and meeting in the middle. When extended, they will project equally, but will not afford the same stability, and for that reason are hardly so suitable. I think you will now see that there has been a mistake, but not where you suppose, and that if you had made up the work you would have seen that the objection you urge, if it be one, is entirely theoretical. I am always pleased to help inquirers, so that if you meet with any further difficulty you may write again; but if you will re-read the paper referred to now, I have no doubt you will find everything quite clear.—D. A.

Battery for Alarum Clock.—A. E. B.—The Leclanché battery is one of the best for this purpose. If, as you say, the battery soon runs down, the fault is not so much in the battery as in the other arrangements. Your connections or line wires are faulty, and so badly constructed or set up as to cause leakage of current. In this way the battery is at work day and night always, and no battery will long withstand such usage without running down. The wires leading from the battery to the clock, from the clock to bell, and from bell back to battery, must be well covered with cotton or silk, and two *wires must not be run along together* under one staple. The battery must not be kept on a wet shelf. On the clock, the little trigger that sets the alarum going must be insulated from the rest of the clock. The whole must be switched off in the daytime. Attend to all these matters, and don't let the alarum ring for more than five minutes at a time; then your battery will last from two to three years. If this don't mend matters, ask again.—G. E. B.

Bichromate Battery for Electric Lighting.—Electricity (*Middlesborough*).—(1) The bichromate battery in its ordinary form is not suitable for electric lighting, because it polarises so quickly after the circuit is closed. But when the cells are used with chromic acid in solution, instead of bichromate of potash, they give more satisfactory results. The solution is made up in a similar manner, and with similar quantities of ingredients, using only the chromic acid instead of bichromate of potash. The number of cells required will depend upon the resistance of the lamp. Find out this, and allow one cell or one pair of elements for each 2 ohms resistance in the lamp, and then one cell to overcome resistance in the wires. (2) A 3½-in. (diameter) ring armature will be quite large enough for the gramme dynamo. You have not mentioned the other parts. Is this all you wanted to know about?—G. E. B.

Electro-Motor.—J. W. (*Handsworth*).—The bobbins for an electro-motor should be wound in opposite directions—one from left to right, and the other from right to left. The outside or finish end of one coil should be connected to the inside or commencing end of the other, so that winding of one coil should be to the other as the lower part of the capital letter S is to the upper part. In connecting the wires, proceed as follows:—Connect one end of a bobbin coil to a binding screw connected with the battery. The other end of the other bobbin coil must go to one of the commutator springs (or brushes), as they are named. The two ends of the armature coil are to be connected to the two sections of the commutator. The other brush or spring must be connected to the opposite pole of the battery. The bobbins may be of brass if the wire is well insulated; but boxwood or ebonite is preferable for bobbins on small machines. In referring to back numbers, please quote title of article and page on which the article is printed.—G. E. B.

Telephone.—J. W. C. (*Clapham Common*).—The telephone sketched by you in your letter is an old form of this instrument brought out by amateurs several years ago, and then named the "pill-box telephone." The wooden pill or tooth-powder box may be anything from 1¾ in. to 2½ in. The core may not be of iron wires, but must be a round bar magnet held in the wooden handle, and protruding into the box far enough to hold a bobbin filled with wire, and with its end close to, but not touching,

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he diaphragm, as shown in your sketch. The diameter of bar magnet may be from ⅜ in. to ½ in. The steel must be hard and well magnetised. The bobbin should be of boxwood or of ebonite, and the reel ends from 1¼ in. to 1¾ in. in diameter, to suit the size of box. The bobbin must be filled with No. 36 B.W.G. silk-covered copper wire wound on in regular layers. The ends of the wires should be run through holes in the handle to two small binding screws at the sides for convenience of connecting to the line wires. The vibrating diaphragm, or disc, must be of very thin charcoal iron plate, or the ferrotype plate used by photographers. It must be pinched tightly between the edge of the box and cover all round equally, but free to bulge in and out in the middle. The cover may be held on with three fine screws. It must be hollowed on the outside from the edges to centre, or to edges of ¾-in. hole in the middle, as you suggest. No battery will be required, as this is a magnetic telephone, worked by current from the magnet. The lines should be of No. 18 or 20 copper wire well insulated and supported on insulators. It must also be kept away from the rear neighbourhood of telegraph wires and electric bell wires. The range of action in this telephone is limited, but I think it is effective up to fifty yards. Of course you must have a pair of these instruments—one for transmitting, and one for receiving the sounds.—G. E. B.

Folding Chair and Table.—A. J. B. (*Dover*).—Your combined folding chair and table seems to be a compact arrangement, but has the disadvantage that the user once in the chair will require an attendant to bring anything he may wish to put on the table, unless he first puts all he may require on the ground beside the chair before shutting himself in.—F. C.

Binn's Endless Blind Cords. — J. J. M. (*Leicester*).—This is not a new invention. In fact it is so old, I think, that the patent rights must have expired. I do not know the maker, or if made still; but Pitman, Son & Co., Wells Street, Falcon Square, E.C., are, I should say, the most likely people to get it from. It is quite impossible to give answers in "Shop" until a few weeks after they have been received.

Terra-Cotta Figures.—E. P. W. (*Stratford*).—Terra-cotta figures may be bought in Piccadilly, London, at Bellman & Ivey's (37), or at F. Ahrend and Co.'s (165). Plaster figures would, however, look as well when bronzed, and would be much less costly.—M. M.

Index to WORK.—W. H. R.—As it has been already stated, an index will be prepared for each volume of WORK.

Electro-Motor for Steam Launch.—ELECTRO.—In reply to your request for "a paper or two on the construction of an electro-motor accumulator, etc., to drive a small launch about 20 feet long, for up-river work, my object would be to get the greatest amount of power with the lightest possible accumulator." I can only say that the subject will be taken in hand as soon as an opportunity occurs.

Silver-Steel Hand Saw.—G. B. P. (*Birmingham*).—Messrs. Spear & Jackson, Ætna Works, Sheffield, send out their saws in quarter dozens, so that you might get one for yourself direct from the manufacturers, if you can prevail on two of your friends to take the others. I am astonished to learn that you cannot get the saw noticed in No. 8 of WORK, page 124, in Birmingham, at any dealers in hardware. If you give the order to any retail dealer, I imagine he would procure a quarter dozen, and take his chance of selling the other two. Of course, R. Melhuish & Sons would get one for you, but what a roundabout way of getting a thing in Birmingham from Sheffield, *viâ* London!

Serial Papers in WORK.—H. W. (*Edinburgh*).—Various things are under consideration, which, if adopted, will in all probability commend themselves to most readers of the Magazine, and that which you mention in your communication will receive attention. Your other question is answered elsewhere.

Map Mounting.—H. G. (*Brentford*). — Map mounting as an amateur has always been more or less a failure, so far as I am concerned; but the least unsatisfactory result was with a coarse, white muslin, which is so open that it allows the parts to work through freely. I paste the map well, and then lay the muslin lightly over it, waiting until it is nearly dry to fold it, with white paper inserted between the surfaces, and then press it under a light weight.—E. B. S.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Bronzing a Gun Barrel.—LANCASHIRE JACK (*Preston*) writes:—"As an anxious reader of your valuable paper, I beg leave to ask for a recipe how to bronze a gun barrel."

Distempering Wood.—BELL asks:—"Can you give me directions for distempering wood?—a process often used, I believe, for decorating plain deal dressing tables, etc. I understand the mixture is useful to give articles a coat with previous to painting, as it fills up knots and the edges of a cut across the grain."

Mechanograph. — H. M. (*Oldham*) writes: — "Would you please tell me how to make a mechanograph, as I cannot buy one in our town—Oldham? There are two sorts, one that is made of five or six sticks, about 6 in. long, and the other of a piece of wood the shape of an egg, with a wire hoop, at one end a piece of string."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Bevelled Cog Wheels.—B. F. (*Liverpool*) writes in reply to POTTER (see page 222):—"POTTER does not state size. I have seen small ones about 1 in. diameter, or less, for 6d. each, in a tool shop near Lord Street, Liverpool; they are to be got at most of the watch tool shops in many towns, where the clockmakers go for what they require, also the model makers, Bateman, London, and others; and I often see them in brokers' shops, second-hand machinery dealers, etc., Booth & Co., Park Lane, Liverpool; or if you require bevel helical spur or double bevel the maker of every sort for the trade is Urquhart, Lindsay, & Co., Blackness Foundry, Dundee. Write for price list, and say size required."

Books on the Power Loom and Weaving.—J. W. C. (*Liverscdge*) writes in reply to D. B. (*Perth*) (see page 253):—"One of the best books on weaving and the power loom is 'Weaving,' by T. R. Ashenhurst, of the Bradford Technical College, and may be had from Messrs. Emmott and Co., New Bridge Street, Manchester, 12s. Also a good book is 'Cloth Manufacture,' by Mr. R. Beaumont of the Yorkshire College, Leeds; and can be had either from the author, or Messrs. G. Bell and Sons, York Street, Covent Garden, London, 7s. 6d. I enclose my card, and any further information in any branch of the textile trades I shall be glad to supply you with. I am a weekly reader of WORK, and wish you success."

Marbling Washstand Tops.—F. P. (*Newport, Mon.*) writes in reply to W. H. J. (*Stratford*) (see page 222):—"If W. H. J. is a practical man, understanding the nature of the ordinary pigments and vehicles of painting, I should think there must be something very special, either as to time given for marbling or the style of imitation required, in the work mentioned for such a question to be submitted. Most cheap furniture work is got up and grained in distemper; but assuming the top to be paint, and a cheap finish only required, a coat of quick-drying white lead painted (mixed with equal parts turpentine and japanners' gold size) can be spread and marbled upon with willow charcoal at once; soften the veins by lightly drawing a brush over them, and in a couple of hours it could be varnished. If cheap imitation of sienna is desired, paint first with quick white, and when dry, marble with the usual tools and pigments, using equal parts turps and gold size for the wash—that is as water is used in water-colour painting. Any further questions would be cheerfully answered by F. P."

Flat or Dead Black.—F. P. (*Newport, Mon.*) writes in reply to OPIFEX (see page 218):—"Without wishing to question the practical value of the recipe given for making the above, a line on the subject from one who has prepared and used, professionally, gallons of such liquid may be acceptable to some readers. Purchase the 'drop' black (ivory drop black is the correct name), already ground in turpentine, thin with more turpentine, and add sufficient of japanners' gold size, about one-eighth part weight or bulk, to 'bind' the black. Any copal oil varnish will answer the purpose equally well, providing too much is not added, as the more varnish or gold size used the more lustre the black will dry with. Black japan and pestle and mortar are quite unnecessary; such round-about recipes as we sometimes get on similar subjects might well give place to the results of practical and professional experience and usage."

Gear Wheels for Lathe.—C. J. W. (*Beccles*) writes in reply to C. E. H. (*Warrington*) (see page 254):—"Messrs. Lloyd & Co., Steelhouse Lane, Birmingham, supply wheels in rough so cleanly cast as hardly to require any finishing beyond boring. The following are about prices in rough; any number of teeth, odd or even:—

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25 ,, 30	,, ...	5d.
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And so on in proportion. I should say these are of 14 pitch for 3-in. centre lathe, but no doubt these pieces will be a guide to C. E. H."

Flour Paste Souring.— BING writes in reply to J. R. (*Skerries*) (see page 238):—"One pennyworth cobblers' paste, thin with warm water; when cold add one teaspoonful methylated spirit; well mix. I have used this for same purpose, and it will keep for a month."

IMPORTANT PRIZE COMPETITION.

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Full particulars of the Scheme will be found in WORK No. 17, page 254.

Trade Notes and Memoranda.

THE Fifty-seventh Annual Exhibition of the Royal Cornwall Polytechnic Society will open at Falmouth on Tuesday, 10th September, 1889. Medals and prizes are offered in special exhibitions of domestic lighting, mechanics, chemistry and electricity, fine arts, photography, natural history, and "Lander" competition. Lists of prizes and all further information may be obtained from the Secretary, Edward Kitto, F.R.Met.S., the Observatory, Falmouth.

THE South Wales Art Society and Sketching Club will hold its second annual exhibition in the Public Hall, Queen Street, Cardiff, on or about August 21st, as will be hereafter announced. Works will be received at the Public Hall, Cardiff, on Wednesday and Thursday, August 14th and 15th. The committee are prepared to receive the following for exhibition:—Recently-executed pictures, drawings, and sketches in all mediums, and on all materials ordinarily in use. Sculpture and modelling, carving in wood, stone, and other material efficient for the purpose. Metalwork, inlaying and mosaic in panels. Small articles of furniture or fittings, etc., which display artistic design or workmanship.

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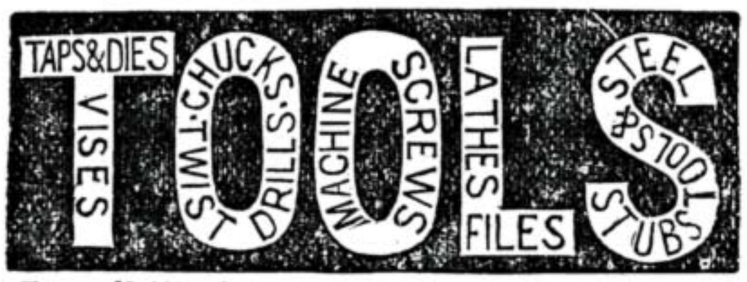

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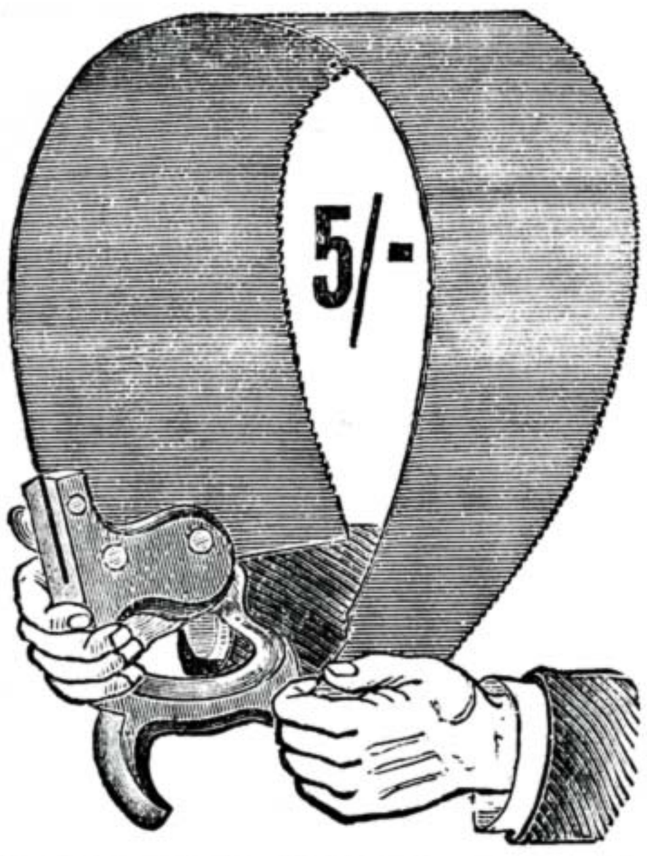

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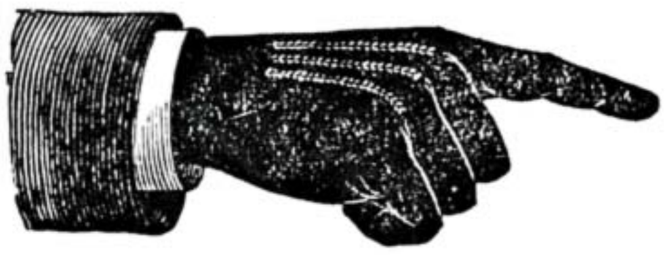

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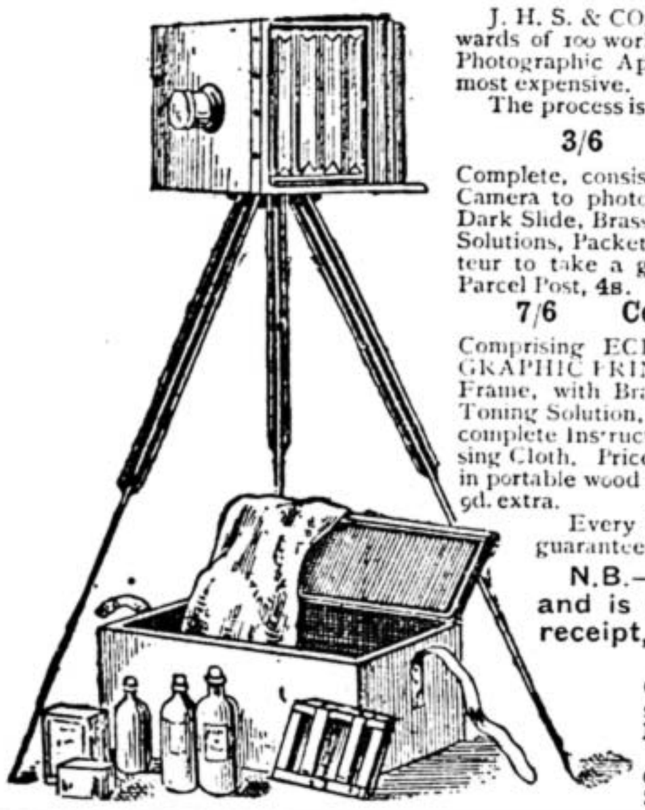

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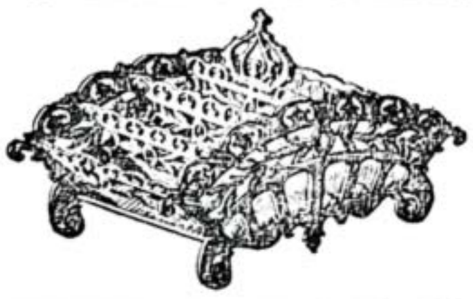

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